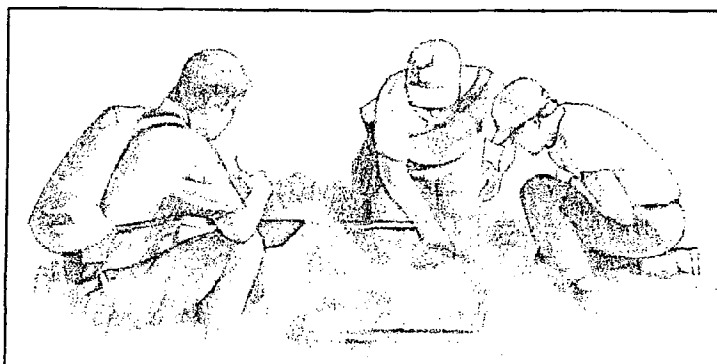


Task 10
FY 1993

FINAL PRODUCT DCR-Heritage
Natural Area Mgmt. Team & Model Plans

Natural Area Source Book:

A guide for land managers, scientists,
educators and conservation planners within
the Virginia Coastal Resources
Management Area



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Technical Report #95-7



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NATURAL AREA SOURCE BOOK:

**A Guide for Land Managers, Scientists, Educators, and
Conservation Planners within the
Virginia Coastal Resources Management Area**

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Technical Report #95-07**

This project was funded by the Department of Environmental Quality's Coastal Resources Management Program through Grant #NA370Z0360-01 of the National Oceanic and Atmospheric Administration Office of Coastal Resource Management Act of 1972 as amended, and the Department of Conservation and Recreation.

Cover illustration by Jeffrey Gaither, depicts biological monitoring.

NATURAL AREA SOURCE BOOK

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We wish to thank everyone who responded to questionnaires, submitted suggestions, supplied information about specific federal and state agencies, universities, private organizations and individuals, and importantly, granted permission for their respective names or affiliations to be listed in this book. Certainly, without the time, assistance, and input from these people, development of a Natural Area Source Book would not have been possible.

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I. Introduction

1. Project goals and objectives
2. Overview of Coastal Plain

Project Goals and Objectives

Virginia's Coastal Zone is rich in biodiversity. Recent inventories conducted by Virginia Department of Conservation and Recreation scientists have identified over 250 natural areas which support natural heritage resources in the Coastal Zone. Natural Heritage Resources are habitats of rare plant and animal species, rare and exemplary natural communities, and significant geologic features. Within the Coastal Zone, or Coastal Resource Management Area, at least 63 natural areas are found on public or private conservation lands. These conservation lands are managed partly, if not entirely, for their biodiversity and aesthetic values. To assist land managers and resource experts in the complex task of appropriately managing natural areas, the Department of Conservation and Recreation has produced a Natural Area Source Book. Goals of the project, as related to the Source Book are as follows:

1. To establish an interdisciplinary team of resource managers, scientists and experts knowledgeable about specific resources and land management techniques. This team provides a) guidance in collection and analysis of ecological data for natural areas, b) input and guidance on inclusion of specific information for a natural area source book.
2. To produce a Natural Area Source Book for land managers, scientists, educators and conservation planners within Virginia's Coastal Resources Management Area.

The Natural Area Source Book provides land managers, scientists, educators and conservation planners with a current source for information about existing natural areas and natural area management issues within the Coastal Resource Management Area. The Natural Area Source Book contains 1) descriptions of natural areas, ownership, management and location, 2) a comprehensive guide to agencies, organizations, academic institutions and individuals that may be knowledgeable about specific resources, or natural area protection and management, 3) an extensive bibliography of related topics, and 4) a guide to resource management planning, and a completed Resource Management Plan for the North Landing River Natural Area Preserve.

Overview of the Coastal Plain

For purposes of the Natural Area Source Book, the Coastal Zone is essentially synonymous with the Coastal Resource Management Area, or the Coastal Plain physiographic province. The Coastal Plain is the youngest of Virginia's physiographic provinces. It is bordered to the north by Maryland, south by North Carolina, west by Virginia's Piedmont Plateau, and to the east by the Atlantic Ocean. This area includes 17 cities and 29 counties, and boasts extensive coastline along the Atlantic Ocean and the Chesapeake Bay. The Coastal Plain grades gently from approximately 60 meters above sea level at the Fall Line (at the eastern edge of the Piedmont Plateau) to below sea level in the Atlantic Ocean. It also possesses the warmest climate in Virginia (Woodward and Hoffman, 1991), and therefore, a large number of southern plant and animal species are able to survive here at or near their northern range limit.

Four major rivers, the Potomac, Rappahannock, York, and James Rivers and numerous tributary rivers and creeks dissect the northern Coastal Plain and flow into the Chesapeake Bay. The area now known as the Chesapeake Bay was historically the drainage basin for the Susquehanna River, and the four rivers listed above were originally tributaries to the old Susquehanna River. When sea level rose after glacial melting, part of the old Susquehanna River basin flooded, creating the Chesapeake Bay. Tributary river basins also flooded, dissecting the remaining land into four peninsulas, the Northern Neck, the Middle Peninsula, The Lower Peninsula and the Eastern Shore (Woodward and Hoffman, 1991). On the northern Coastal Plain, there is a pronounced change of surface character from north to south. The relatively narrow Northern Neck is deeply dissected by short, high-gradient streams which flow through a terrain described as hilly and well-drained. Southward the surface gradually becomes flatter toward the James River (Woodward and Hoffman, 1991). Rivers are bordered by extensive freshwater tidal marshes, and marl ravines and woodlands support numerous rare plant and animal species.

The eastern shore and barrier islands form a long peninsula along the outer Coastal Plain. Active wave and wind processes continue to shape the coastline here, composed primarily of unconsolidated sands and gravels. The terrain is relatively low, supporting extensive barrier beaches, salt marshes, and pine flatwoods. Technically the Coastal Plain extends eastward (below sea level) to the edge of the North American continent. The submerged section may extend down as much as 180 meters below sea level at the Continental Shelf (Woodward and Hoffman, 1991).

The southern Coastal Plain includes the Dismal Swamp drainage basin and parts of the Chowan River drainage. Both systems drain toward the Albemarle Sound in North Carolina. The Great Dismal Swamp, Northwest River, North Landing River and Back Bay form significant watersheds within the Dismal Swamp drainage basin. These watersheds are noted nationally for their extensive estuarine and freshwater wetlands. The Chowan drainage basin stretches from the Piedmont to the Coastal Plain. Within the Coastal Plain, the drainage

The Great Dismal Swamp, Northwest River, North Landing River and Back Bay form significant watersheds within the Dismal Swamp drainage basin. These watersheds are noted nationally for their extensive estuarine and freshwater wetlands. The Chowan drainage basin stretches from the Piedmont to the Coastal Plain. Within the Coastal Plain, the drainage basin is represented by two major rivers, the Nottoway and Blackwater Rivers. Throughout much of their courses, these rivers are slow, entrenched streams with deep channels. Unique sandy upland habitats tend to form on the sandy east sides of these rivers as they meander through the Coastal Plain. Long-leaf pine barrens and turkey oak sandhills, two rare vegetative communities, are restricted to this region of the Coastal Plain.

Information collected on rare plants, animals and vegetative communities is managed by the Department of Conservation and Recreation's Biological and Conservation Data System (BCD), a powerful, state-of-the-art information management tool designed to track information on elements of biological diversity, occurrences of those elements, conservation sites, ecological monitoring programs, and additional pertinent data. The BCD System provides current and comprehensive information for the benefit of science and research, safe economic growth and conservation driven by sound science.

In addition to rich pelagic and estuarine communities, Virginia's Coastal Plain supports an extremely diverse array of freshwater wetland and terrestrial communities. Natural communities are distinct assemblages of plants and animals which interact with one another and their physical environment. Some of the most notable natural communities within Virginia's Coastal Plain are pocosins, seasonally wet pine flatwoods, seasonal ponds, pine and turkey oak sandhills, freshwater tidal marshes, dune and swale wetlands, salt marshes, and maritime loblolly pine forests. In the ongoing inventory of the natural resources of Virginia, the Department of Conservation and Recreation locates, maps and monitors communities as elements of natural diversity, just as it does plant and animal species. The Department has documented 45 rare and exemplary community occurrences in Virginia's Coastal Plain.

Virginia's Coastal Plain flora and fauna are rich and varied. The diversity of species is the result of the region's warm climate, vast array of wetland habitats, and unique upland habitats. Four hundred twelve rare plants and animals are documented from the Coastal Plain by the Department of Conservation and Recreation. Appendix A of the source book contains a list of all natural heritage resources for the Coastal Plain region. This list is grouped by plants, animals, and communities and includes the Heritage Network global rank, state rank, federal status, and state status for each species and community.

II. Managed Natural Areas Within the Coastal Zone

1. Description of natural areas
2. List and map of managed natural areas

Managed Natural Areas Within Virginia's Coastal Zone

Presently, there are 63 managed natural areas within public and private conservation ownership in Virginia's Coastal Resource Management Area, also called the Coastal Zone. Many other significant natural areas occur in private ownership within this region. This report however, features those natural areas which have been identified by Department of Conservation and Recreation scientists as lands supporting rare flora, fauna, and native vegetative communities, and which are managed to conserve natural heritage resources. Numerous federal, state, local, and private interests are involved in the conservation of natural areas. For purposes of this Natural Area Source Book, managed natural areas have been broadly categorized into one of five classifications: state lands, federal lands, local lands, university lands, and private conservation lands. A complete list and map of Managed Natural Areas within the Coastal Zone immediately follow this narrative.

A natural area, defined by the Virginia Natural Area Preserves Act of 1989, (Article 3, Code of Virginia, section 10.1-209), "means any area of land, water, or both land and water, whether publicly or privately owned, that retains or has reestablished its natural character, though it need not be completely natural and undisturbed: or which is important in preserving rare or vanishing flora, fauna, native ecological systems, geological, natural historical, scenic or similar features of scientific or educational value benefitting the citizens of the Commonwealth." Natural areas serve as important reserves for rare organisms, they help maintain ecosystem stability, and provide important baseline information for long-term ecological monitoring. They are ideal sites for research, and provide tremendous opportunities for public education and passive recreation.

Natural areas provide four key benefits to the citizens of Virginia. They provide public access to the outdoors; they provide unique educational and passive recreation opportunities; they enhance tourism to Virginia (Virginia's Eastern Shore Migratory Bird Festival generates over \$52,000 per year in revenue, and Cape May and the Delaware Shore realize some four billion dollars per year in nature related tourism); and they conserve Virginia's rich natural heritage.

Lack of scientific data and the absence of planning for safe economic growth has placed some of southeast Virginia's species and communities at risk. Certain communities such as pocosins, Atlantic white cedar swamps, and long-leaf pine and turkey oak woodlands were once common in this region. Originally, pocosins and cedar swamps extended over 600 square miles in this area. Now roughly 20 square miles of this rare habitat remain intact and are restricted to the Great Dismal Swamp National Wildlife Refuge and the North Landing River Natural Area Preserve. In a similar manner, long-leaf pine and turkey oak woodlands once covered vast regions of southeast Virginia. Less than 3000 acres remain, and of that,

only Old Dominion University's 350 acre Blackwater Ecologic Preserve is protected and managed as a natural area.

Citizens throughout the Commonwealth support the conservation of natural areas for scientific, educational, aesthetic and economic values. Indeed, results of The Commonwealth Poll, a 1994 poll conducted by Survey Research Laboratory, of Virginia Commonwealth University, indicate that citizens of Virginia support natural area conservation. Fifty eight percent of respondents strongly agreed that "Virginia should try to identify and locate rare plants and animals." In the same poll, a large majority of Virginia citizens (85%) "strongly agreed" that "Virginia should protect previously untouched habitats." Through passage of a 95 million dollar Parks and Natural Areas Bond (of which 11.5 million dollars is dedicated toward natural area acquisition and public access improvements), Virginia citizens recently made a commitment to conserve natural areas for the benefit of future generations.

To reach a still larger segment of Virginia's population and to garner support for conserving Virginia's rich biological diversity, we must continue to increase awareness in the Commonwealth's citizens about natural areas and their inherent benefits. Providing opportunities for passive recreation and environmental education will enhance and nourish a better understanding of the necessity to conserve these areas, add to the quality of life in the region, and enhance economic development. Increasingly, the public has acknowledged the importance that natural areas play in educational and interpretive programs, as demonstrated at such areas as Seashore State Park and Natural Area, and Bethel Beach Natural Area Preserve.

Accommodating both public and scientific use of natural areas while preserving valuable natural resources is a challenge for land managers, particularly in Virginia's Coastal Zone. Land managers are faced with complex environmental issues which require a thorough knowledge of the resource base, careful planning, and integrated management programs. Additional information is necessary to determine the best techniques for managing certain natural environments and rare species habitats. Baseline data on ecological processes are central to sound management planning, but this information is often lacking or difficult to obtain. By understanding the processes (for example, fire, herbivory, and hydrology) operating on natural landscapes, land managers are able to better judge effects of their activities on the land and those special resources they attempt to manage and preserve. The Natural Area Source Book should serve as a useful guide for land managers, conservation planners and educators in the Coastal Zone. It provides information on natural area conservation, rare species, natural communities, restoration and management techniques, knowledgeable contacts, and pertinent references. The Virginia Department of Conservation and Recreation's resource management plan for the North Landing River is appended to the source book and serves as a model for developing management programs for existing private and public conservation lands.

MANAGED NATURAL AREAS WITHIN VIRGINIA'S COASTAL ZONE

Managed Area Name	Ownership	Managing Agency/Institute
▲ - State Lands (Department of Conservation and Recreation, Department of Game and Inland Fisheries)		
1. Bethel Beach Natural Area Preserve	Dept. of Conservation and Recreation (DCR)	DCR
2. Bushmill Stream Natural Area Preserve	DCR	DCR
3. Caledon Natural Area	DCR	DCR
4.* Charles C. Stierly Natural Area	DCR	DCR
5. Chippokes Plantation State Park (portions of)	DCR	DCR
6. False Cape State Park (portions of)	DCR	DCR
7. Hughlett Point Natural Area Preserve	DCR	DCR
8. Kiptopeke State Park (portions of)	DCR	DCR
9. Kitterwan Wildlife Management Area	DCR	DCR
10. Leesylvania State Park (portions of)	Dept. of Game and Inland Fisheries (DGIF)	DGIF
11. Mason Neck State Park (portions of)	DCR	DCR
12. North Landing River Natural Area Preserve	DCR	DCR
13. Northwest River Natural Area Preserve	DCR	DCR
14.* Parkers Marsh Natural Area	DCR	DCR
15. Princess Anne Wildlife Man. Area (portions of)	DGIF	DGIF
16. Seashore State Park and Natural Area (portions of)	DCR	DCR
17.* White Oak Swamp Natural Area	Commonwealth of VA	Dept. of General Services/Dept. of Forestry
18.* William B. Trower Bayshore Natural Area Preserve	DCR	DCR
19.* Wreck and Bone Island Natural Area Preserve	DCR	DCR, TNC, VA Coast Reserve
20. York River State Park (portions of, part of NERR)	DCR	DCR

■ - Federal Lands (Military, National Park Service, Fish and Wildlife Service)		
1.* A. P. Hill Military Reservation (portions of)	U.S. Dept. of Defense (USDOD)	USDOD
2. Assateague Island National Seashore (portions of)	U.S. Dept. of the Interior (USDOI)	U.S. National Park Service (USNPS)
3. Back Bay National Wildlife Refuge (portions of)	USDOI	USFWS
4. Chincoteague National Wildlife Refuge (portions of)	USDOI	USFWS
5. Colonial National Historical Park (portions of)	USDOI	USNPS
6. Eastern Shore of VA National Wildlife Refuge (portions of)	USDOI	USFWS
7. Featherstone National Wildlife Refuge (portions of)	USDOI	USFWS
8. Fisherman's Island National Wildlife Refuge (portions of)	USDOI	USFWS
9.* Fort Belvoir Military Reservation (portions of)	USDOD	USDOD
10.* Fort Lee Military Reservation (portions of)	USDOD	USDOD
11.* Fort Story Military Reservation (portions of)	USDOD	USDOD
12. George Washington Memorial Parkway (portions of)	USDOI	USNPS

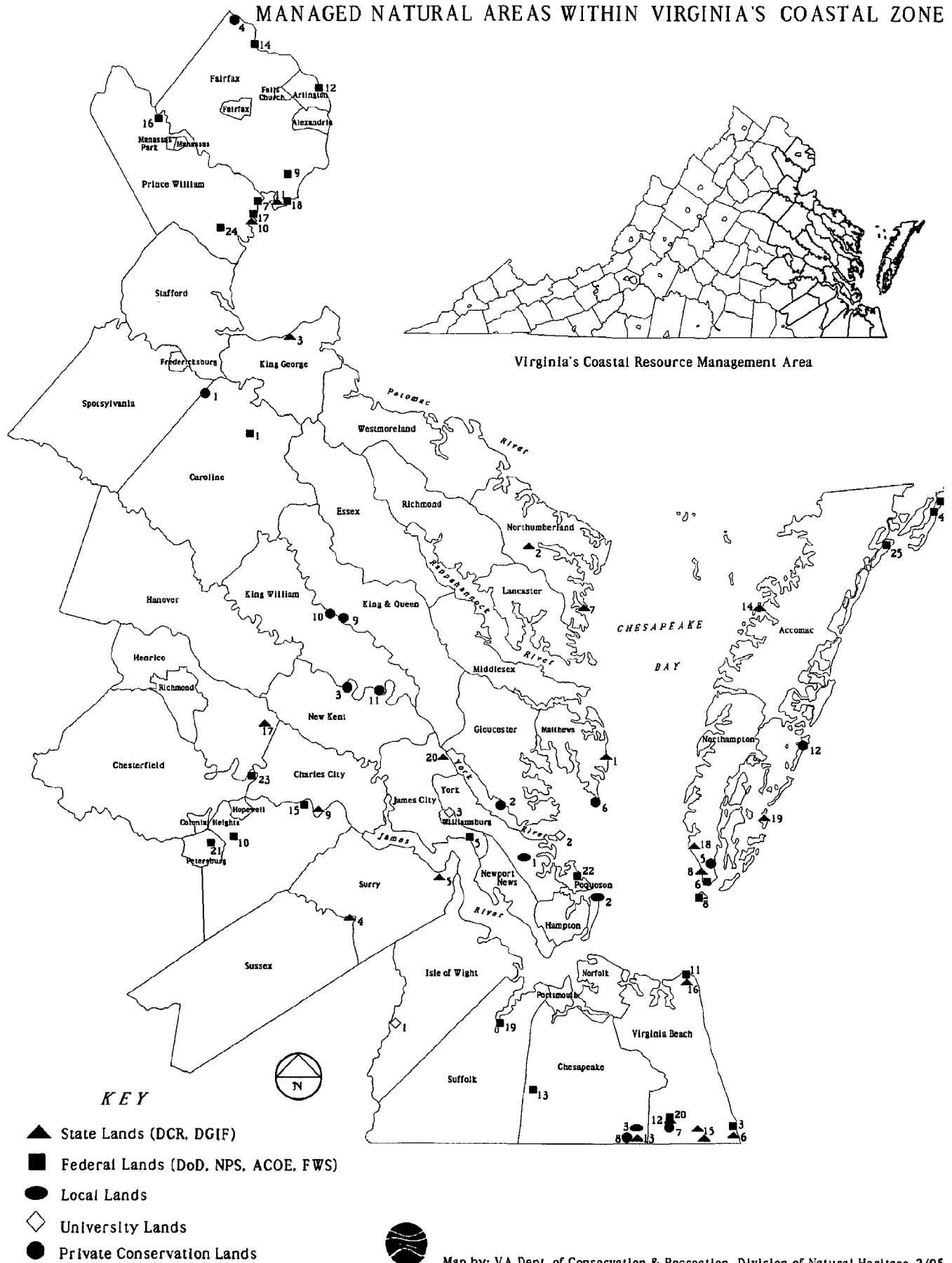
(Access to Natural Areas marked with an asterisk (*) is by PERMISSION ONLY from the managing agency listed.)

(page 2 of 2, continued: Managed Natural Areas Within Virginia's Coastal Zone)

Managed Area Name	Ownership	Managing Agency/Institute
- Federal Lands (continued)		
13. Great Dismal Swamp National Wildlife Refuge (portions of)	USDOI	USFWS
14. Great Falls National Park (portions of)	USDOI	USNPS
15. James River National Wildlife Refuge (portions of)	USDOI	USFWS
16. Manassas Nat'l Battlefield Park (portions of)	USDOI	USNPS
17. Marumco National Wildlife Refuge (portions of)	USDOI	USFWS
18. Mason Neck National Wildlife Refuge (portions of)	USDOI	USFWS
19. Nansemond National Wildlife Refuge (portions of)	USDOI	USFWS
20. North Landing River Islands (portions of)	USDOI	USFWS
21. Petersburg Nat'l Battlefield Park (portions of)	U.S. Army Corps of Engineers	ACOE, TNC-VAFO
22. Plum Tree Island National Wildlife Refuge (portions of)	USDOI	USNPS
23. Presquile National Wildlife Refuge (portions of)	USDOI	USFWS
24. Prince William Forest Park	USDOI	USFWS
25.* Goddard Space Flight Ctr/Wallops Flight Facility (portions of)	Nat'l Aeronautics and Space Administration	USNPS
- Local Lands		
1. Grafton Ponds Natural Area Preserve	City of Newport News	City of Newport News/DCR
2. Grandview Beach Nature Preserve	City of Hampton	City of Hampton, Dept. of Recreation
3. Northwest River Park (portions of)	City of Chesapeake	Chesapeake Dept. of Recreation
- University Lands		
1.* Blackwater Ecological Preserve	Brd of Visitors, Old Dominion Univ. (ODU)	ODU
2.* Goodwin Islands (National Estuarine Research Reserve)	Brd of Visitors, College of William and Mary	VIMS
3.* William and Mary College Woods (portions of)	Brd of Visitors, College of William and Mary	College of William and Mary
- Private Conservation Lands		
1.* Alexander Berger Memorial Sanctuary	The Nature Conservancy (TNC)	TNC-VA Field Office (VAFO)
2.* Catlett Islands (National Estuarine Research Reserve)	privately owned	Virginia Institute of Marine Science (VIMS)
3.* Cumberland Marsh Preserve	TNC	TNC-VAFO
4.* Fraser Preserve	TNC	TNC-VAFO
5.* Magothy Bay Natural Area	TNC	TNC-VA Coast Reserve
6.* New Point Comfort Preserve	TNC	TNC-VAFO
7.* North Landing River Preserve	TNC	TNC-VAFO
8.* Northwest River Preserve	TNC	TNC-VAFO
9.* Orange Grove Preserve (TNC Managed Area)	privately owned	TNC-VAFO
10.* Owens Marsh Preserve	privately owned	TNC-VAFO
11.* Sweet Hall Marsh (National Estuarine Research Reserve)	privately owned	VIMS
12.* Virginia Coast Reserve	TNC	TNC-VA Coast Reserve

(Access to Natural Areas marked with an asterisk (*) is by PERMISSION ONLY from the managing agency listed.)

MANAGED NATURAL AREAS WITHIN VIRGINIA'S COASTAL ZONE



**III. Guide to Agencies, Organizations, Academic Institutions and
Individuals Knowledgeable about Specific Resources, or
Natural Area Protection and Management.**

CONTACT / RESOURCE DIRECTORY

Listed below are some agencies, organizations, academic institutions and individuals that may be knowledgeable about natural area protection, management and/or specific resources. These are broadly grouped under the following headings: **Chesapeake Bay/Coastal Resources Protection; Forestry; Land and Resource Conservation and Environmental Advocacy; Local and Regional Planning; Natural Resource Identification and Conservation; Recreation; Regulation; Research and Education; Soil and Water Conservation; Wetlands Planning, Regulation and Conservation;** followed by a list of **Resource Experts**. Certainly, this directory cannot possibly include all pertinent contacts and resources available within the coastal zone area, and is intended only as a guide.

CHESAPEAKE BAY / COASTAL RESOURCES PROTECTION

Alliance for the Chesapeake Bay, Inc.

mission/assistance: The Alliance for the Chesapeake Bay, Inc. is a coalition of environmentalists, business representatives, government officials, sports enthusiasts and others who are working together to protect a priceless resource, the Chesapeake Bay.

contact: staff

(804) 775-0951

Chesapeake Bay Foundation

mission/assistance: Chesapeake Bay Foundation's mission is to "Save the Bay". The foundation offers programs on land management, land conservation, water quality protection, wetlands protection, and environmental education.

contact: staff, Chesapeake Bay Foundation

(804) 780-1392

Chesapeake Bay Local Assistance Department (CBLAD)

mission/assistance: The mission of the Chesapeake Bay Local Assistance Department is to protect the Chesapeake Bay and its tributaries from pollution caused by the use and development of land. To achieve this, the Department will serve the citizens of the Commonwealth by working in partnership with local governments to implement programs that protect and improve water quality, while supporting a healthy economy and other public policy objectives. CBLAD provides technical assistance in the areas of regulatory interpretation, nonpoint source pollution control, site design issues, and comprehensive planning for water quality protection.

contact: Scott Kudlas, Chief of Planning Assistance

(804) 243-7229

C. Scott Crafton, Chief of Regulatory Assistance (804) 371-7503

(Or use the 800 number: (800) 243-7229)

Chesapeake Bay National Estuarine Research Reserve in Virginia (Virginia Institute of Marine Science)

mission/assistance: Chesapeake Bay NERR's mission in Virginia is to protect the Bay's natural resources, to conduct estuarine research that will aid coastal decision making, and to make a significant contribution to estuarine education in Virginia.

contact: manager

(804) 642-7135

United States Army Corps of Engineers

mission: The USACOE provides safe navigation along the Atlantic Intracoastal Waterway and protection of Natural Resources under the Corps ownership.

contact: Andrew Reid

(804) 441-7641

United States Department of Coast Guard, Fifth Coast Guard District
contact: Gary L. Ott (804) 898-2320

Virginia Cooperative Extension - Chesapeake Bay Programs
mission/assistance: Virginia Cooperative Extension, Chesapeake Bay Program's mission is to coordinate and to provide educational programs with local extension agents, Soil and Water Conservation Districts, and others on ways to reduce non-point source pollution from reaching the Chesapeake Bay and its tributaries.
contact: Randall F. Shank, Chesapeake Bay Education Coordinator (804) 371-8884

Virginia Department of Conservation and Recreation (DCR), Division of Soil and Water Conservation, Chesapeake Bay Programs, Bureau of Non-point Source Programs
mission/assistance: DCR's mission is to conserve Virginia's natural and recreational resources.
contact: James W. Cox (804) 786-3957

Virginia Department of Conservation and Recreation (DCR), Division of Soil and Water Conservation, Chesapeake Bay Programs, Bureau of Rivers and Shores
mission/assistance: DCR's mission is to conserve Virginia's natural and recreational resources.
contact: L.S. Button (804) 371-7536

Virginia Department of Conservation and Recreation (DCR), Division of Soil and Water Conservation, Chesapeake Bay Programs, Bureau of Urban Programs
mission/assistance: DCR's mission is to conserve Virginia's natural and recreational resources.
contact: J. Michael Flagg (804) 786-3959

Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, Shoreline Programs Section, Shoreline Erosion Advisory Service
mission/assistance: DCR's mission is to conserve Virginia's natural and recreational resources. Assistance can be provided as education and technical assistance to private properties, government agencies or the general public on shoreline erosion, shoreline erosion control and coastal zone management.
contact: Lee Hill (804) 642-7121

Virginia Department of Environmental Quality
mission/assistance: Virginia Department of Environmental Quality's mission is to protect the environment of Virginia in order to promote the health and well-being of the Commonwealth's citizens.
contact: Larry Minock (Coordinator of Interstate Chesapeake Bay Programs) (804) 762-4320

Virginia Institute of Marine Science
The College of William and Mary - School of Marine Science
mission/assistance: The School of Marine Science is one of four professional graduate schools of the College of William and Mary. The objective of the educational program is to provide a fertile and stimulating learning environment for students preparing for careers in marine science.
contact: Berch Smithson (804) 642-7382

Virginia Marine Resources Commission (VMRC)

mission/assistance: Virginia Marine Resources Commission holds regulatory jurisdiction over all commercial and sports fishing, marine fish, marine shellfish, and marine organisms in the tidal waters of Virginia. VMRC holds permit jurisdiction on all projects involving use of state owned submerged lands and authority over use or development in vegetated and non-vegetated tidal wetlands and coastal primary sand dunes.

contact: Robert Grabb, Tony Watkinson (804) 247-2250

FORESTRY

Virginia Department of Forestry

mission/assistance: The Virginia Department of Forestry's mission is to maintain a forest resource to meet the needs of the Commonwealth. The VADOF can provide technical assistance to private landowners to assist with management of natural resources, and leadership to help protect water quality associated with forest activity. The VADOF enforces the Forest Water Quality Law, and provides assistance with community forest projects. The VADOF also provides rural fire protection and control, assistance with marketing forest products, reforestation, pest management and other environmental concerns. Biological identification, protection, silvicultural prescription, and forest management can be handled with in-house experts or referral.

contact: James Starr, Headquarters (804) 977-6555 Charlottesville
John Carroll, Region 1 (804) 834-2300 Waverly
William Saunders, Region 2 (804) 443-2211 Tappahannock

Virginia Forestry Association (VFA)

mission/assistance: The mission of the Virginia Forestry Association is the promotion of stewardship and wise use of our forest resource by landowners and the forest industry, for the economic and environmental benefits of all Virginians.

contact: Paul R. Howe, Exec. Dir. (804) 741-0836

LAND AND RESOURCE CONSERVATION AND ENVIRONMENTAL ADVOCACY

American Farmland Trust

contact: Dennis Bidwell, Director of Land Protection (202) 659-5170

American Fisheries Society, Virginia Chapter

mission/assistance: The American Fisheries Society's mission is to promote the conservation, development, and wise utilization of fisheries, both recreational and commercial. The Virginia Chapter is affiliated with American Fisheries Society Headquarters.

contact: Michael C. Odom (703) 332-9210

Back Bay Restoration Foundation

P.O. Box 868, VA Beach, VA 23451

contact: Joy Eliassen, Pres. (804) 427-0685

Cape Henry Audubon Society

contact: president, or exec. board member (804) 622-0372

Natural Area Source Book: contacts, resources

Center for Plant Conservation

mission/assistance: The Center for Plant Conservation's mission is conserving rare and endangered plants of the United States through cultivation and research. The Center for Plant Conservation is a national organization headquartered at the Missouri Botanical Garden in St. Louis and governed by an independent national Board of Trustees.

contact: staff

(314) 577-9450

Citizens for a Better Eastern Shore

Northampton County Chapter, P.O. Box 882, Eastville, VA 23347

contact: Suzanne Westcoat, President

Conservation Council of Virginia (CCVA)

mission/assistance: CCVA provides a dynamic forum in which to coordinate development and promotion of effective policies for the sustainable use and preservation of our natural resources. The council is a broad coalition of organizations and individuals concerned with conservation opportunities in the Commonwealth.

contact: staff CCVA, PO Box 106, Richmond, VA 23201

The Conservation Fund

mission/assistance: The Conservation Fund collaborates with private and public partners to save land. A nonprofit organization, the Fund is dedicated to advancing land conservation in America with creative ideas and new resources. The Fund provides specialized skills and services ranging from land planning and acquisition to ecological assessment and communications support.

contact: Patrick F. Noonan, President

(703) 525-6300

Elizabeth River Project

contact: Marjorie Mayfield, President

(804) 625-3648

Friends of Back Bay Refuge

contact: Molly Brown, President (c/o Back Bay Nat'l Wildlife Refuge) (804) 721-2412

Friends of the Rappahannock

contact: president, exec. board member

(703) 373-3448

Historic Rivers Land Conservancy

contact: Carolyn Lowe

(804) 565-3167

James River Association

mission/assistance: The James River Association works for the preservation of the scenic, environmental, historical and recreational characteristics of the James River watershed in our area, consistent with orderly economic development.

contact: Patti Jackson

(804) 730-1921

Kiptopeke Environmental Station, Research & Education Laboratory (KESTREL)

mission/assistance: KESTREL is a non-profit foundation focusing attention on the migration of birds and insects on Virginia's Eastern Shore. The goals of KESTREL are to contribute to the understanding of bird and insect migration by, 1) promoting, organizing, directing and financially supporting studies, 2) producing educational materials and 3) serving as a resource for information.

contact: Bill Williams, President

(804) 253-6779 or (804) 229-6095

Natural Area Source Book: contacts, resources

The Mattaponi and Pamunkey Rivers Association

mission/assistance: The Mattaponi and Pamunkey Rivers Association is dedicated to preservation of the history, ecology, scenic values, recreation and economy of the Mattaponi and Pamunkey Rivers.

contact: Billy Mills (804) 775-0951

National Wilderness Institute (NWI)

contact: staff (703) 836-7404

Natural Areas Association

mission/assistance: The Natural Areas Association's mission is to advance the preservation of natural diversity. The association works to inform, unite, and support persons engaged in identifying, protecting, managing, and studying natural areas and biological diversity.

contact: staff (314) 878-7850 (815) 964-6666

The Nature Conservancy (Virginia Field Office)

mission/assistance: The Nature Conservancy's mission is to preserve plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. Land protection strategies, land management.

contact: Michael Lipford, Director - Judy Dunscomb Dir. of Science and Stewardship (804) 295-6106

The Nature Conservancy (Virginia Coast Reserve)

mission/assistance: The Nature Conservancy's mission is to preserve plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. The Virginia Coast Reserve is a barrier island wilderness area containing some 45,000 acres of sandy beaches, salt marsh, and adjacent upland along the Eastern Shore of Virginia. The Reserve is recognized as one of the most important privately held natural areas in America, and has been designated by the United Nations as a World Biosphere Reserve in recognition of its great ecological value.

contact: John M. Hall, Director - Barry Truitt, Dir. of Science and Stewardship (804) 442-3049

Northern Neck Chapter of the Audubon Society

contact: Porter Kier (804) 529-6071

Northumberland Association for Progressive Stewardship (NAPS)

mission/assistance: NAPS is a non-profit, non-partisan Virginia public service organization dedicated to the orderly growth and environmental welfare of Northumberland County.

contact: Michael S. Harwood (804) 580-4801

Piedmont Environmental Council

mission/assistance: Piedmont Environmental Council is a nonprofit organization formed to conserve natural resources and the pastoral landscape of a nine-county region of the Northern Virginia Piedmont. Public education and services to public officials and citizens, covering: land use; farmland retention; open space conservation; historic preservation; and rural planning legislation. Active statewide and federally on rural conservation issues.

contact: Charles S. Whitehouse (703) 347-2334

Richmond Audubon Society

contact: president or exec. board member (804) 257-0813

Southeastern Association for Virginia's Environment (SAVE)

mission/assistance: SAVE is a coalition of concerned individuals, organizations and businesses dedicated to the preservation and protection of the total environment of the southeastern region of Virginia. Through unified and concerted efforts, this coalition believes that they can make a difference in the policies and attitudes that will shape the environment and quality of life for generations to come.

contact: Sue Carlyle, President (804) 481-2538

The Trust for Public Land

mission/assistance: The Trust for Public Land is a national nonprofit land conservation organization that protects land as a living resource for present and future generations. A problem-solving organization, TPL helps communities, public agencies and nonprofit organizations acquire and protect open space. TPL shares knowledge of nonprofit land acquisition processes and pioneers methods of land conservation and environmentally sound land use.

contact: Debi Lee Osborne, Director, Chesapeake Lands Project (202) 543-7552

Virginia Chapter of the Wildlife Society

contact: staff (804) 296-4731

Virginia Environmental Endowment

mission/assistance: Virginia Environmental Endowment (VEE) is a nonprofit grantmaking corporation whose purpose is to improve the quality of the environment. VEE funds programs aimed at creating economically-viable, ecologically-sustainable communities, preventing pollution, conserving natural resources, and providing environmental education.

contact: Gerald P. McCarthy, Executive Director (804) 644-5000

Virginia Environmental Network

contact: staff (804) 644-0283

Virginia Herpetological Society

408 Franklin Drive, Blacksburg, VA 24060

contact: Ron Southwick

Virginia Native Plant Society

mission/assistance: The VNPS and chapters throughout Virginia seek to further appreciation and conservation of Virginia's wild plants and habitats. Programs emphasize public education, protection of endangered species, habitat preservation, and encouragement of appropriate landscape use of native plants. Includes both amateurs and professionals.

contact: Nicky Staunton (703) 368-9803

Virginia Nurserymen's Association, Inc.

mission/assistance: The mission of the Virginia Nurserymen's Association is to enhance the development of professional nurserymen, to assist in improving efficiency and profitability of the profession, and to represent and promote the nursery industry to the Commonwealth and the Nation.

contact: Jeffrey B. Miller, Exec. Dir. (703) 382-0943

Natural Area Source Book: contacts, resources

Virginia Outdoors Foundation

mission/assistance: The Virginia Outdoors Foundation's mission is to preserve Virginia's natural scenic, historic, scientific, open space and recreational areas by means of private philanthropy. The Foundation accepts gifts of cash, stock, real property or open spaces easements to achieve its purpose.

contact: Virginia E. McConnell, Director (804) 786-5539

Virginia Society of Ornithology

mission/assistance: The VSO concentrates on all aspects of the birds of VA. Recent major activities include collaboration with state agencies on large field research projects, a long-term banding operation on the Eastern Shore, and field trips to bird hot spots. The VSO also publishes a semiannual journal, a quarterly newsletter, and books on Virginia's birds. Additionally, the VSO provides an annual conservation award and a biannual research grant to people involved with the birds of the Commonwealth. This is a statewide organization with 24 local chapters.

contact: Bill Akers, President (804) 330-3289
Thelma Dalmas (804) 239-2730

Virginia Zoological Society

contact: staff (804) 624-9937

Wildlife Habitat Enhancement Council

mission/assistance: The Wildlife Habitat Enhancement Council is a non-profit, non-lobbying organization of representatives from conservation and environmental groups as well as corporate America. The Council's unique and innovative purpose is to promote and nurture the enhancement of corporate property - representing about one-quarter of private U.S. land - for the benefit of wildlife. In addition to helping wildlife, Council-supported activities focus on "the human dimension." Citizens, employees, managers, conservationists, state and federal agency personnel and community groups work together to protect wildlife while enhancing relationships with one another. 1010 Wayne Avenue, Suite 1240, Silver Spring, MD 20910

contact: staff

LOCAL AND REGIONAL PLANNING

Accomack - Northampton Planning District Commission

mission/assistance: The Accomack-Northampton Planning District Commission's mission is to promote the orderly and efficient development of the physical, social and economic elements of the District [Accomack and Northampton Counties and 19 incorporated towns], through regional planning and encouraging and assisting governmental subdivision to plan for the future. The PDC maintains or has access to a variety of data and information resources.

contact: James M. McGowan (804) 787-2936

Caroline County Department of Planning and Community Development

mission/assistance: The Caroline County Department of Planning and Community Development's mission is to implement and enforce all environmental regulations. Staff are available to answer environmental/planning questions with regard to Caroline County.

contact: Andrea K. Hornung (804) 633-4303

Charles City County Planning Department

contact: staff, Planning Department (804) 829-9217

Chesapeake Bay Local Assistance Department

contact: Donna E. Cesan (804) 371-7504

Chesterfield County Planning Department

mission/assistance: The Chesterfield County Planning Department undertakes long and short range planning for land use and development.

contact: Thomas E. Jacobson, Director (804) 748-1050

City of Alexandria Planning Department

contact: staff, Planning Department (703) 838-4666

City of Chesapeake, Department of Planning

mission/assistance: As per the Chesapeake City Charter, the Planning Dept. has the following responsibilities: to prepare a comprehensive plan and its continued review and revision; to advise the City Manager on implementation of the comprehensive plan and other matters affecting physical development of the City; to prepare other reports, studies, and evaluations as required by the City Manager; and to advise the Planning Commission in the exercise of its responsibilities and in connection therewith to provide necessary staff assistance. This office deals with various natural resource matters since they often are relevant issues to land use and development. This office is a source for various types of information, such as maps, aerial photographs, studies, and information on local resource management programs, as well as information dealing with land use and development.

contact: L. Lee Dydin, Planner (804) 547-6176

City of Colonial Heights Planning Department

contact: staff, Planning Department (804) 520-9275

City of Falls Church Planning Department

contact: staff, Planning Department (703) 241-5040

City of Hampton Planning Department

contact: staff, Planning Department (804) 727-6132

City of Hopewell, Department of Development

contact: Milton Martin (804) 541-2220

City of Newport News, Department of Planning

contact: staff, Planning Department (804) 247-8428

City of Norfolk Planning Department

contact: staff, Planning Department (804) 441-2375

City of Petersburg Planning Department

contact: staff, Planning Department (804) 733-2308

City of Poquoson Planning Department

contact: staff, Planning Department (804) 868-3535

City of Portsmouth Planning Department

contact: staff, Planning Department (804) 393-8836

City of Richmond, Dept. of Community Development, Div. of Comprehensive Planning

mission/assistance: The Department of Community Development's mission is to plan, promote, coordinate and implement a coherent structure for the maintenance and development of the social and physical environment to enhance the life of the current and future citizens of the City of Richmond.

contact: staff, Dept. of Community Development (804) 780-6335

City of Virginia Beach Planning Department

contact: staff, Planning Department (804) 427-4621

City of Williamsburg, Department of Planning

contact: Reed Nester (804) 220-6130

Crater Planning District Commission

mission/assistance: The Crater Planning District Commission's mission is to promote the orderly and efficient development of the physical, social and economic elements of the Planning District.

contact: Dennis K. Morris, Executive Director (804) 861-1666

Essex County Planning Department

contact: staff, Planning Department (804) 443-2434

Fairfax County, Office of Comprehensive Planning

mission/assistance: The Fairfax County, Office of Comprehensive Planning's mission is to prepare and interpret policies and ordinances to ensure that environmental protection and ecological resource conservation objectives are met as a function of the development process.

contact: staff, Environment and Development Review Branch (703) 324-1380

Gloucester County Planning Department

contact: staff, Planning Department (804) 693-4040

Hampton Roads Planning District Commission

mission/assistance: The HRPDC is responsible for regional planning and problem solving in the functional areas of Physical and Environmental Planning, Transportation, Economics, Legislative and Information Services and Human Resources. It provides a forum for the elected and appointed officials of the region's local governments to address common problems and opportunities. The HRPDC compiles information and completes technical studies in each of its functional responsibilities. Through an extensive Committee structure, the HRPDC facilitates information exchange among the localities, state and federal agencies and the private sector. Consensus approaches are developed for consideration by the Commission. The Commission includes the Cities of Chesapeake, Franklin, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach and Williamsburg, and the Counties of Gloucester, Isle of Wight, James City, Southampton and York.

contact: Arthur L. Collins, Executive Director/Secretary (804) 420-8300

John M. Carlock, Director of Physical and Environmental Planning (804) 420-8300

Hanover County Planning Department

contact: staff, Planning Department (804) 537-6171

Henrico County Planning Office

mission/assistance: The Henrico County Planning Office's mission is to prepare the general plans for charting the future development of the County. Development of such plans requires analysis of the physical environment, existing land use conditions, economic market realities, and the availability of public services. The Planning Office also reviews specific development proposals to assure conformity with the appropriate County ordinances.

contact: Audrey Anderson, County Planner (804) 672-4602

Isle of Wight County Planning Department

contact: staff, Planning Department (804) 357-3191

James City County Planning Department

mission/assistance: The James City County Planning Department's mission is to provide analysis of planning activities related to public facilities, utilities, transportation and land use. This department assists in the creation and achievement of community goals and visions and manage development activities in a way that focuses on achievement of those goals and visions.

contact: Wayland Bass, County Engineer (804) 253-6671

King and Queen County Planning Department

contact: staff, Planning Department (804) 785-6272

King George County Planning Department

contact: staff, Planning Department (703) 775-7111

King William County, Department of Community Development

contact: Dennis W. Carrey (804) 769-4933

Lancaster County, Virginia, Department of Planning and Land Use

contact: G. Cabell Lawton, IV (804) 462-5220

Mathews County, Department of Planning and Zoning

mission/assistance: This department can provide information regarding local land use.

contact: Ted Costin, AICP (804) 725-4034

Middlesex County Planning Department

contact: staff, Planning Department (804) 758-3382

Middle Peninsula Planning District Commission

mission/assistance: Middle Peninsula Planning District Commission is a regional planning agency serving middle peninsula localities in land use, environmental, transportation, housing, and economic development issues.

contact: Jim Uzel, Environmental Programs Coordinator (804) 750-2311

Natural Area Source Book: contacts, resources

New Kent County Planning Department

mission/assistance: New Kent County Planning Department's mission is to encourage well planned, orderly growth as a means to meet the physical, economic, and social needs of county residents. To preserve and protect the natural environment while permitting development to occur in a manner consistent with the capacity of land to handle development.

contact: staff, New Kent County Planning Department (804) 966-9690

Northampton County Planning Department

contact: staff, Planning Department (804) 678-0443

Northern Neck Planning District Commission

contact: Randy Wingfield, Planning District Commission (804) 529-7400

Northumberland County Planning Department

contact: staff, Planning Department (804) 580-4342

Prince George County Planning Department

contact: staff, Planning Department (804) 733-2608

Prince William County Planning Department

contact: staff, Planning Department (703) 792-6830

Rappahannock Area Development Comission (RADCO Planning District)

mission/assistance: The RADCO Planning District's mission is to promote long-range planning of environmental, physical, social, economic and transportation elements in the District. RADCO staff could assist a natural area resource manager by coordinating between that manager and local governments to enhance their relationship through regional support. Staff could bring issues affecting the natural area to the attention of decision-makers and allow for discussion of those issues. RADCO staff could also provide assistance on various projects and increase awareness among the public of the natural area as an asset to the region.

contact: Stephen Manster, Executive Director - Sandra Rives-Swope, Env. Planner (703) 373-2890

Richmond County Planning Department

mission/assistance: This department serves as planning and land use program administrator for Richmond County. Duties include inventory and analysis of natural resources.

contact: William E. Duncanson (804) 333-3415

Richmond Regional Planning District Commission

mission/assistance: The Richmond Regional Planning District Commission's mission is to plan physical, social and economic development of the district.

contact: Mr. Larry McCarty (804) 358-3684

Southampton County Planning Department

contact: staff, Planning Department (804) 653-3008

Spotsylvania County Planning Department

contact: staff, Planning Department (703) 582-7146

Natural Area Source Book: contacts, resources

Stafford County Planning Department

contact: staff, Planning Department (703) 371-4614

Surry County Planning Department

contact: staff, Planning Department (804) 294-5210

Westmoreland County Planning Department

contact: staff, Planning Department (804) 493-0120

York County Department of Community Development

mission/assistance: York County Dept. of Community Development's mission is implementation of York County's Comp. Plan by ensuring that development which does occur is in accordance with the County's rural character and is consistent with the carrying capacity of the land.

contact: Cynthia S. Taylor (804) 890-3525

NATURAL RESOURCE IDENTIFICATION AND CONSERVATION

Department of Mines, Minerals and Energy

contact: staff (800) 552-3831

Goddard Space Flight Center/Wallops Flight Facility (GSFC/WFF)

National Aeronautics and Space Administration, Goddard Space Flight Center/Wallops Flight Facility, GSFC/WFF Environmental Branch, Wallops Island, VA 23337-5099

contact: Pamela Whitman, Resource Manager (804) 824-2137

United States Department of Defense, Fort A.P. Hill Military Reservation

Fort A. P. Hill Military Reservation, Bowling Green, VA 22427

contact: John Phillips, Resource Manager (804) 633-8255

United States Department of Defense, Fort Belvoir Military Reservation

Fort Belvoir Military Reservation, Fort Belvoir, VA 22060-5113

contact: Dorothy Keough, Resource Manager (703) 355-7968

United States Department of Defense, Fort Lee Military Reservation

Directorate of Public Works, Bldg. 6205 (ATZM-EMO), Fort Lee, VA 23801-5200

contact: Carol Anderson, Resource Manager (804) 765-4803

United States Department of Defense, Fort Story Military Reservation

Fort Story Military Reservation, c/o Resource Manager, Fort Eustis, Fort Eustis, VA 23604-5000

contact: Tony Rizzio, Resource Manager (804) 878-4123

United States Department of the Interior, Fish and Wildlife Service

mission/assistance: The U.S. Fish and Wildlife Service's mission is to conserve, protect, and enhance the nation's fish and wildlife and their habitats for the continuing benefit of the American people. The service can provide Natural Areas managers with information on all Federal environmental laws and programs; natural resource management and restoration techniques; endangered and rare species; environmental contaminants; and sources of environmental education.

contact: Virginia Field Office - Karen L. Mayne (804) 693-6694
Back Bay National Wildlife Refuge - Joseph F. McCauley (804) 721-2412
Chincoteague National Wildlife Refuge - John D. Schroer (804) 336-6122
Eastern Shore of VA National Wildlife Refuge - Sherman W. Stairs (804) 331-2760
Featherstone National Wildlife Refuge - J. Frederick Milton, Jr. (703) 690-1297
Fisherman's Island National Wildlife Refuge - Sherman W. Stairs (804) 331-2760
Great Dismal Swamp National Wildlife Refuge - Lloyd A. Culp, Jr. (804) 986-3706
James River National Wildlife Refuge - Barry G. Brady (804) 733-8042
Marumsc National Wildlife Refuge - J. Frederick Milton, Jr. (703) 690-1297
Mason Neck National Wildlife Refuge - J. Frederick Milton, Jr. (703) 690-1297
Nansemond National Wildlife Refuge - Lloyd A. Culp, Jr. (804) 986-3706
Plum Tree Island National Wildlife Refuge - Lloyd A. Culp, Jr. (804) 986-3706
Presquile National Wildlife Refuge - Barry G. Brady (804) 733-8042

U.S. Department of the Interior, National Park Service, Southeast Regional Office

mission/assistance: The National Park Service's mission is to preserve and protect the natural resources for the enjoyment of all visitors and for future generations.

contact:

Mid-Atlantic Regional Office - Dave Reynolds, Chief, Branch of Natural Resource Management (215) 597-5372
Mid-Atlantic Regional Office - Denise Cooke, Coord. for Air, Water and Endangered Species (215) 597-9978
Assateague Island National Seashore - Carl Zimmerman, Natural Resources Manager (410) 641-1441
Colonial National Historic Park - Chuck Rafkind, Natural Resources Manager (804) 898-8677
Fredericksburg National Battlefield Park - Susan Alberts (703) 373-0834
George Washington Birthplace - Natural Resources Manager (804) 224-2142
George Washington Memorial Parkway - Natural Resources Manager --- --- ---
Great Falls National Park - Dwight Madison, Park Manager (703) 285-2965
Manassas National Battlefield Park - Natural Resources Manager (703) 754-7107
Petersburg National Battlefield Park - Ray Ahlbrandt, Natural Resources Manager (804) 732-3531
Prince William Forest Park - Natural Resources Manager (703) 221-7181
Richmond National Battlefield Park - Mike Bristow, Natural Resources Manager (804) 226-1981

Virginia Academy of Science (VAS), Archaeology Section

mission/assistance: The VAS, Archaeology Section disseminates information concerning archaeology in Virginia. (Attn: Dennis Blanton, c/o Dept. of Anthropology, College of William and Mary.)

contact: Dennis B. Blanton (804) 221-2584

Virginia Department of Game and Inland Fisheries

mission/assistance: Virginia Department of Game and Inland Fisheries' mission is to manage Virginia's wildlife and inland fish to maintain optimum populations of all species to serve the needs of the Commonwealth.

contact: Wildlife - Bob Duncan, Chief (804) 367-6878
Glen Askins, Regional Manager (804) 253-4180
Rick Busch, Regional Manager (804) 899-4169
Fisheries - Gary Martel, Chief (804) 367-1004
Mitchell Norman, Regional Manager (804) 424-6719
John Kauffman, Regional Manager (804) 296-4731
Nongame Program - Karen Terwilliger, Nongame Biologist (804) 367-1000
Mike Pinder, Aquatic Nongame Biologist (703) 951-6992
Fish and Wildlife Info. System - Rebecca K. Wajda (804) 367-8351
Environmental Services - Raymond T. Fernald (804) 367-8364

Virginia Department of Historic Resources

mission/assistance: Virginia Department of Historic Resources's mission is to encourage the identification, evaluation, and preservation of Virginia's significant historical and cultural resources. Offers technical advice on preservation of historic structures and archaeological sites, and on compliance with state and federal preservation regulations. Arranges artifact loans and provides design assistance for educational exhibits as well as assistance to teachers seeking to include historic preservation in their curricula.

contact: David Dutton, Project Review Division (804) 786-3143
Catherine Slusser, Director, Technical Assistance Division (804) 786-4143

Virginia Department of Conservation and Recreation, Division of Natural Heritage

mission/assistance: Department of Conservation and Recreation's (DCR) mission is to conserve Virginia's natural and recreational resources. DCR's Division of Natural Heritage works to inventory and conserve Virginia's biological diversity. The Division produces an inventory of Virginia's natural diversity, provides information on rare, threatened and endangered species and natural environments to citizens of the Commonwealth. DCR conserves natural areas through a variety of protection tools, and implements model programs for the stewardship of Virginia's natural heritage resources.

contact: Thomas L. Smith, Division Director (804) 786-7951
Leslie D. Trew, Inventory Program Manager (804) 371-6206
Larry R. Smith, Natural Areas Program Manager (804) 371-6205
Caren A. Caljouw, Stewardship Coordinator (804) 371-6204
Steve Carter-Lovejoy, Information Manager (804) 786-8377
Lesa S. Berlinghoff, Project Review Coordinator (804) 371-2708

Virginia Department of Conservation and Recreation, Division of State Parks

mission: DCR's mission is to conserve Virginia's natural and recreational resources. The Division of State Parks works to protect, conserve and manage significant state natural, recreational, historical and cultural resources and to provide recreational and educational services, opportunities and facilities consistent with needs of Virginians and their guests.

contact: Resource Manager - Theresa Duffey (804) 786-5053

Virginia Farm Bureau Federation

contact: staff (804) 784-1374

RECREATION

Accomack County Parks and Recreation Department

contact: William Allen (804) 787-3900

Alexandria Department of Recreation, Parks & Cultural Activities

contact: Richard Kauffman (703) 838-4842

Arlington Co. Department of Parks, Recreation and Community Resources

contact: Alice Foster (703) 358-3323

Caroline County Parks and Recreation Department

contact: Donnell Howard (804) 633-7277

Charles City County Department of Parks and Recreation

contact: Darrell Crittendon (804) 829-9227

City of Chesapeake, Parks, Recreation and Building Maintenance Department

mission/assistance: The Chesapeake Parks, Recreation and Building Maintenance Department's mission is to provide opportunities and facilities to serve the leisure needs of citizens year round to include: leisure program classes, athletic programs, special events, senior programs, handicap programs, and to maintain the buildings, parks and recreational fields for those programs.

contact: Park Planner (804) 547-6411

City of Chesapeake, Parks, and Recreation Department: Northwest River Park

mission/assistance: Northwest River Park's mission is to provide passive recreational offerings to the citizens of Chesapeake and their guests; to provide protection and conservation of the park; and to provide protection of the habitat and sanctuary for its natural resources as well as educational programs about its environment.

contact: W. N. Petree Manager, Northwest River Park (804) 421-7151

Chesterfield County Parks and Recreation Department

contact: Mike Golden (804) 748-1623

Colonial Heights Recreation and Park Department

contact: Sean E. Gleason (804) 520-9390

Essex County Parks and Recreation Department

contact: Sylvia Allen (804) 443-2470

City of Fairfax Parks and Recreation Department

contact: Michael B. Cadwallader (703) 385-7858

Fairfax County Department of Recreation and Community Services

contact: W. Michael Kendrick (703) 324-5501

Fairfax County Park Authority

contact: James Heberlein (703) 246-5700

Falls Church Recreation and Parks Department

contact: Howard E. Herman

(703) 241-5077

Federal Lands-to-Parks Program (National Park Service)

mission/assistance: Through the Federal Lands-to-Parks Program, State and local agencies may acquire land and facilities at no cost to meet park and recreation needs.

contact: staff

(404) 331-2610

Fredericksburg Recreation Department

contact: Robert Antozzi

(703) 372-1088

Fredericksburg-Stafford County Park Authority

contact: Ray Grizzle

(703) 373-7909

Gloucester County Parks and Recreation Department

contact: Carol Steele

(804) 693-2355

Hampton Department of Parks and Recreation

contact: Elizabeth Walker

(804) 727-6347

Hanover County Parks and Recreation Department

contact: Brad Ashley

(804) 798-8062

Henrico County Recreation and Parks Department

contact: Tom Blekicki

(804) 672-5104

City of Hopewell Department of Recreation and Parks

contact: William Mitchell

(804) 541-2304

Isle of Wight County Public Facilities Authority

contact: Alan Nogiec

(804) 357-2291

James City County Parks and Recreation

contact: Needham Cheely, III

(804) 229-5676

King George Parks and Recreation Department

contact: Jo Turek

(703) 775-4386

King William County Parks and Recreation Department

contact: Tim Smith

(804) 769-4928

Mathews County Parks and Recreation Department

contact: John Christopher

(804) 725-7171

Middlesex County Parks and Recreation

contact: Beth Stilwagen

(804) 758-4330

Natural Area Source Book: contacts, resources

Newport News Department of Parks and Recreation

contact: Ronald Burroughs (804) 247-8451

Norfolk Department of Parks and Recreation

contact: Stanley A. Stein (804) 441-2400

Northampton County Parks and Recreation Department

contact: Barry Randall (804) 678-5179

Northern VA Regional Park Authority

contact: Darrell Winslow (703) 352-5900

Northumberland County Parks and Recreation Department

contact: Angeline Sisson (804) 580-8901

Petersburg Recreation Department

contact: Alan Archer (804) 733-2394

Poquoson Parks and Recreation

contact: Art Thatcher (804) 868-3580

Portsmouth Parks and Recreation

contact: L. Pettis Patton (804) 393-8481

Prince George County Department of Recreation and Parks

contact: Barney Lee (804) 733-2646

Prince William County Park Authority

contact: Peggy Delinocci (703) 792-7060

Richmond City Department of Recreation and Parks

contact: Allison Baker (804) 780-5715

Stafford County Parks and Recreation Department

contact: Michael Scott (703) 720-4871

Suffolk Parks and Recreation

contact: Dinesh Tiwari (804) 925-6325

Surry County Parks and Recreation Department

contact: Earvin Jones (804) 294-3044

U.S. Department of the Interior, National Park Service, Southeast Regional Office

mission/assistance: The National Park Service's mission is to preserve and protect the natural resources for the enjoyment of all visitors and for future generations.

contact:

Mid-Atlantic Regional Office - Dave Reynolds, Chief, Branch of Natural Resource Management (215) 597-5372
Mid-Atlantic Regional Office - Denise Cooke, Coord. for Air, Water and Endangered Species (215) 597-9978
Assateague Island National Seashore - Carl Zimmerman, Natural Resources Manager (410) 641-1441
Colonial National Historic Park - Chuck Rafkind, Natural Resources Manager (804) 898-8677
Fredericksburg National Battlefield Park - Susan Alberts (703) 373-0834
George Washington Birthplace - Natural Resources Manager (804) 224-2142
George Washington Memorial Parkway - Natural Resources Manager (804) 224-2142
Great Falls National Park - Dwight Madison, Park Manager (703) 285-2965
Manassas National Battlefield Park - Natural Resources Manager (703) 754-7107
Petersburg National Battlefield Park - Ray Ahlbrandt, Natural Resources Manager (804) 732-3531
Prince William Forest Park - Natural Resources Manager (703) 221-7181
Richmond National Battlefield Park - Mike Bristow, Natural Resources Manager (804) 226-1981

City of Virginia Beach, Department of Parks and Recreation

mission/assistance: The Virginia Beach Department of Parks and Recreation's mission, or QUEST (Quality, Unified vision, Effective leadership, Service, Team work) is to enhance the quality of life in Virginia Beach by responding to recreational needs of the community through parkland, facilities, and program services.

contact: Ray A. Emerson, Parks Administrator - J. Barry Frankenfield, Parks and Rec. Planner (804) 563-1100

Virginia Department of Conservation and Recreation, Division of Planning and Recreation Resources

mission/assistance: DCR's mission is to conserve Virginia's natural and recreational resources. The Division of Planning and Recreation Resources provides planning, recreation and public access technical assistance. The Scenic Byways and Virginia Scenic Rivers Programs are within this division, which maintains a public access database for coastal Virginia. Visual resource assessments and evaluations are provided.

contact: John Davy - Derral Jones - Janit Potter (804) 786-2556

Virginia Department of Conservation and Recreation, Division of State Parks

mission: DCR's mission is to conserve Virginia's natural and recreational resources. The Division of State Parks works to protect, conserve and manage significant state natural, recreational, historical and cultural resources and to provide recreational and educational services, opportunities and facilities consistent with needs of Virginians and their guests.

contact: Resource Manager - Theresa Duffey (804) 786-9025
Belle Isle State Park - Timothy G. Shrader, III (804) 462-5030
Caledon State Park and Natural Area - John R. Zawatsky (703) 663-3861
Chippokes Plantation State Park - Danette C. McAdoo (804) 294-3625
False Cape State Park - Bryan K. Anderson (804) 426-7128
George Washington Grist Mill Historical State Park - David F. Stapleton (703) 780-3383
Kiptopeke State Park - Scott A. Flickinger (804) 331-2267
Lake Anna State Park - Douglas H. Graham (703) 854-5503
Leesylvania State Park - James A. Klakowicz (703) 670-0372
Mason Neck State Park - W. Jeff Foster (703) 550-0960
Pocohontas State Park - Edward Swope (804) 796-4255
Seashore State Park and Natural Area - Fred Hazelwood, IV or Philip A. Koury (804) 481-2131

Natural Area Source Book: contacts, resources

Westmoreland State Park - Willie E. Bowen
York River State Park - Stephanie Turner

(804) 493-8821
(804) 556-3036

Virginia Department of Conservation and Recreation, Division of Volunteerism and Constituent Services
mission/assistance: DCR's mission is to conserve Virginia's natural and recreational resources.
contact: Karen F. Marcus, Director (804) 786-2294

Virginia Department of Game and Inland Fisheries

mission/assistance: Virginia Department of Game and Inland Fisheries' mission is to provide opportunity for all to enjoy wildlife, inland fish, boating and related outdoor recreation.

contact: Wildlife -	Bob Duncan, Chief	(804) 367-6878
	Glen Askins, Regional Manager	(804) 253-4180
	Rick Busch, Regional Manager	(804) 899-4169
Fisheries -	Gary Martel, Chief	(804) 367-1004
	Mitchell Norman, Regional Manager	(804) 424-6719
	John Kauffman, Regional Manager	(804) 296-4731
Lands and engineering -	Jack Raybourne, Chief	(804) 367-8864

Virginia Recreation and Park Society (VRPS)

mission/assistance: The Virginia Recreation and Park Society is a private, non-profit professional organization, founded in 1953 and incorporated in 1956. It's purpose is to unite all professionals, students and interested lay persons engaged in the field of recreation, parks and other leisure services in the Commonwealth of Virginia, into one body and to work together to promote and improve the profession in all its diversity. VRPS is affiliated with the National Recreation Park Association.

contact: staff (804) 730-9447

Westmoreland County Parks and Recreation

contact: Alice Hutnyan (804) 493-8163

Williamsburg Department of Parks and Recreation

contact: Paul Hudson (804) 220-6170

York County Division of Recreational Services

contact: Cheryl Sonderman (804) 890-3500

REGULATION

Chesapeake Bay Local Assistance Department (CBLAD)

mission/assistance: The mission of the Chesapeake Bay Local Assistance Department is to protect the Chesapeake Bay and its tributaries from pollution caused by the use and development of land. To achieve this, the Department will serve the citizens of the Commonwealth by working in partnership with local governments to implement programs that protect and improve water quality, while supporting a healthy economy and other public policy objectives. CBLAD provides technical assistance in the areas of regulatory interpretation, nonpoint source pollution control, site design issues, and comprehensive planning for water quality protection.

contact: Scott Kudlas, Chief of Planning Assistance (804) 243-7229
C. Scott Crafton, Chief of Regulatory Assistance (804) 371-7503
(Or use the 800 number: (800) 243-7229)

North Carolina Department of Agriculture / Plant Conservation Program

mission/assistance: North Carolina Department of Agriculture, Plant Conservation Program's mission is protection of endangered and threatened native plants. This is the legal listing agency for endangered and threatened plant species for North Carolina. It contributes to research, protection and habitat restoration for E & T species. Projects may cross state lines and range anywhere in the southeast, as long as the species is native to North Carolina. Contact person's research interests include presettlement vegetation of southeastern Virginia, presettlement fire ecology of Virginia.

contact: Cecil Frost

(919) 733-3610

United States Army Corps of Engineers

mission: The USACOE administers the Clean Water Act, provides wetlands permitting, and provides safe navigation along the Atlantic Intracoastal Waterway and protection of Natural Resources under the Corps ownership.

contact: Col. Andrew M. Perkins, Jr. Andrew Reid (804) 441-7641

United States Fish and Wildlife Service (USFWS) - Virginia Field Office

mission/assistance: U.S. Fish and Wildlife Service's mission is to conserve, protect, and enhance the nation's fish and wildlife and their habitats for the continuing benefit of the American people. USFWS can provide Natural Areas managers with information on all Federal environmental laws and programs; natural resource management and restoration techniques; endangered and rare species; environmental contaminants; and sources of environmental education.

contact: Karen L. Mayne

(804) 693-6694

Virginia Department of Agriculture and Consumer Services

mission: Virginia Department of Agriculture and Consumer Services mission is protection, conservation and recovery of listed threatened and endangered plant and insect species, as well as the listing of these species as threatened or endangered.

contact: John R. Tate

(804) 786-3515

United States Department of Coast Guard

contact: Gary L. Ott

(804) 898-2320

Virginia Department of Environmental Quality

mission/assistance: Virginia Department of Environmental Quality's mission is to protect the environment of Virginia in order to promote the health and well-being of the Commonwealth's citizens.

contact: Elizabeth Moran, Permit Manager (804) 762-4430

Jack Schubert, Air Toxics, Enforcement & Compliance (804) 762-4303

Bob McEachern, Water Div. Enforcement and Compliance (804) 762-4278

Virginia Department of Game and Inland Fisheries

mission/assistance: Virginia Department of Game and Inland Fisheries mission is to manage Virginia's wildlife and inland fish to maintain optimum populations of all species to serve the needs of the Commonwealth.

contact: Wildlife - Bob Duncan, Chief (804) 367-6878

Glen Askins, Regional Manager (804) 253-4180

Rick Busch, Regional Manager (804) 899-4169

Fisheries - Gary Martel, Chief (804) 367-1004

Mitchell Norman, Regional Manager (804) 424-6719

Natural Area Source Book: contacts, resources

	John Kauffman, Regional Manager	(804) 296-4731
Nongame Program -	Karen Terwilliger, Nongame Biologist	(804) 367-1000
	Mike Pinder, Aquatic Nongame Biologist	(703) 951-6992
Fish and Wildlife Info. System -	Rebecca K. Wajda	(804) 367-8351
Environmental Services -	Raymond T. Fernald	(804) 367-8364

Virginia Marine Resources Commission

mission/assistance: This state agency holds regulatory jurisdiction over all commercial and sports fishing, marine fish, marine shellfish, and marine organisms in the tidal waters of Virginia. Holds permit jurisdiction on all projects involving use of state owned submerged lands and authority over use or development in vegetated and non-vegetated tidal wetlands and coastal primary sand dunes.

contact: Robert Grabb (804) 247-2250

RESEARCH AND EDUCATION

Christopher Newport University, Biology Department

contact: chair, Biology Department (804) 594-7126

Center for Archaeological Research

The College of William and Mary

mission/assistance: This center provides consultation and research services in the areas of archaeology and architectural history, and more generally, historic preservation and cultural resource management.

contact: Dennis B. Blanton, Donald W. Linebaugh (804) 221-2580

The Center for Conservation Biology

The College of William and Mary

mission/assistance: The Center for Conservation Biology is a non-profit organization dedicated to finding practical solutions to current environmental problems. To this end, its focus has been to integrate three complimentary disciplines: Research- staff conducts basic and applied research focused on the functioning of mid-Atlantic ecosystems. Staff at the center strives to select projects that not only fill information needs but also serve as catalysts to increase public awareness and stimulate related work within the region. Education- staff educates students and the public about the conservation and significance of our natural resources. The center also distributes significant research findings and information to assist resource planners and promote informed, responsible decision making. Management- staff initiates and develops comprehensive strategies for the conservation and preservation of mid-Atlantic resources and ecosystems. In addition, center staff assists local, state, and federal agencies in identifying the condition and distribution of sensitive coastal resources.

contact: Dr. Bryan Watts, Director (804) 221-2247

Herbarium, Department of Biology

The College of William and Mary

mission/assistance: The mission of the herbarium at the College of William and Mary is to build and maintain a collection of accurately identified plant specimens representing the vascular flora of the coastal plain of Virginia, in particular, and to a more limited extent, the flora of the southeastern United States. These specimens serve as a historical record of the flora as an aid in identifying "unknowns", and as data for research in plant systematics.

contact: Donna M. E. Ware, Curator (804) 221-2213

School of Marine Science - Virginia Institute of Marine Science

The College of William and Mary

mission/assistance: The School of Marine Science is one of four professional graduate schools of the College of William and Mary. The objective of the educational program is to provide a fertile and stimulating learning environment for students preparing for careers in marine science.

contact: Berch Smithson (804) 642-7382

Eastern Shore Community College

contact: chair, Department of Biology (804) 787-5900

Institute for Chesapeake Bay Studies

contact: staff (804) 633-7249

J. Sergeant Reynolds Community College

contact: chair, Department of Biology (804) 371-3000

John Tyler Community College

contact: chair, Department of Biology (804) 796-4031

Mariner's Museum

contact: staff (804) 595-0369

Maymont Foundation

contact: staff (804) 358-7166

Norfolk Botanical Garden

contact: staff (804) 441-5803

Old Dominion University - Department of Biological Sciences

mission/assistance: Undergraduate and graduate education. Ecological research in a range of ecosystems and specialties (cave biota, marine benthic, wetland plants, mammals, reptiles, fishes, marine microbes, etc.)

contact: Department of Biological Sciences (804) 683-3595

State Arboretum of Virginia

contact: staff (703) 837-1758

Tidewater Community College

Geophysical Sciences and Biology Departments

mission/assistance: Coastal Studies Program-primary course offerings in basic Oceanography, Geology, and Biology. Additional courses in Coastal Ecology, Wetlands Management, Water Quality, Principles of Underwater Research, Laboratory Techniques in Environmental Sciences. The program emphasizes a strong field and laboratory component. The acquisition of a research vessel in spring 1995 will allow greater flexibility and a host of new programs. Community - The department is also interested in any cooperative educational and research programs with agencies throughout the region.

contact: Michael Lyle (804) 427-7189

Fred Stemple, Jr. (804) 427-7191

Natural Area Source Book: contacts, resources

Thomas Nelson Community College

contact: chair, Department of Biology (804) 825-2898

University of Richmond

contact: Valerie Kish, Department of Biology (804) 289-8229

Virginia Commonwealth University - Department of Biology

contact: Leonard A. Smock, Chairman (804) 828-1562

Virginia Living Museum

mission/assistance: Education. The museum has exhibits and programs featuring native Virginia animals and plants.

contact: Pete Money (804) 595-1900

Virginia Marine Science Museum

mission/assistance: Education. The museum houses a large aquarium dedicated to Chesapeake Bay species, as well as numerous other exhibits.

contact: staff (804) 425-3474

Virginia Museum of Natural History

mission/assistance: 1) VMNH provides a permanent repository where specimens of Virginia's natural heritage can be housed, cared for, cataloged, and studied; 2) VMNH can provide assistance in locating voucher specimens and associated information pertinent to natural diversity of the area; 3) curatorial staff may provide identification of vertebrates and invertebrates, conduct inventory programs or instruct others in how to conduct inventory programs, provide relevant literature sources for reference, designate known natural elements in terms of rarity or biological significance; 4) VMNH maintains a listing of collections held in institutions around the state.

contact: Paisley S. Cato, Curator of Collections (703) 666-8600

Virginia State University

contact: chair, Department of Biology (804) 524-5961

Virginia Union University

contact: chair, Department of Biology (804) 257-5611

Virginia Wesleyan College

mission/assistance: Virginia Wesleyan College is a four year liberal arts college.

contact: Verne M. Keefer, Dept. of Biology (804) 455-3247

SOIL AND WATER CONSERVATION

Chesapeake Bay Local Assistance Department (CBLAD)

mission/assistance: The mission of the Chesapeake Bay Local Assistance Department is to protect the Chesapeake Bay and its tributaries from pollution caused by the use and development of land. To achieve this, the Department will serve the citizens of the Commonwealth by working in partnership with local governments to implement programs that protect and improve water quality, while supporting a healthy economy and other public policy objectives. CBLAD provides technical assistance in the areas of regulatory interpretation,

nonpoint source pollution control, site design issues, and comprehensive planning for water quality protection.

contact: Scott Kudlas, Chief of Planning Assistance (804) 243-7229

C. Scott Crafton, Chief of Regulatory Assistance (804) 371-7503

(Or use the 800 number: (800) 243-7229)

Colonial Soil and Water Conservation District (Area III)

mission/assistance: The Colonial Soil and Water Conservation District strives to coordinate and respond to the natural resource interests among agricultural, residential, business and civic groups and local governments in the Counties of Charles City, James City, New Kent and York, and the City of Williamsburg. The conservation district cooperates and communicates with local governments, landholders, schools, civic groups and businesses so that all practical protection is provided for water quality and supply, soil productivity and forest management. Our activities are governed by the Federal, State and Local laws and regulations that are required to be used by our participating jurisdictions.

contact: David W. Meador

(804) 564-1870 or 564-0537

Eastern Shore Soil and Water Conservation District (Area VI)

mission/assistance: The Eastern Shore Soil and Water Conservation District's mission is to provide and develop leadership in natural resources conservation on the Eastern Shore of Virginia through education, the promotion of cooperative programs, and meeting the needs of a diverse clientele. We would be of assistance to a resource manager of a natural area by providing technical and educational assistance.

contact: P. W. Davis, Chairman - Peggy Hutchinson, Administrative Secretary

(804) 787-1251

Hanover-Caroline Soil and Water Conservation District (Area III)

contact: Stephanie Lassiter Martin

(804) 798-8107 or (804) 633-5044

Henricopolis Soil and Water Conservation District (Area III)

mission/assistance: The Henricopolis Soil and Water Conservation District's mission is to provide leadership in the conservation of natural resources in Henrico County, through the promotion of good stewardship and education programs.

contact: Terry S. Ruhlen, District Program Manager

(804) 672-5176

James River Soil and Water Conservation District (Area III)

mission/assistance: The James River Soil and Water Conservation District's mission is to encourage and promote proper management of the soil and water resources within Chesterfield and Prince George Counties.

contact: Tom Sordelett

(804) 748-2235

Northern Virginia Soil and Water Conservation District (Area II)

mission/assistance: NVSWCD promotes the wise use and conservation of soil and water resources and sound environmental policies for Fairfax County. NVSWCD offers technical expertise, educational programs, and community outreach in the soil and water conservation arena.

contact: Paige Shiller

(703) 324-1460

Peanut Soil and Water Conservation District (Area VI)

contact: Troy Griffin

(804) 357-3191 or (804) 539-9270

Prince William Soil and Water Conservation District (Area II)

contact: James Bonar

(703) 361-1710

Three Rivers Soil and Water Conservation District (Area III)

mission/assistance: The Three Rivers Soil and Water Conservation District achieves soil and water conservation through positive, informed leadership, education and technical assistance for all people.

contact: L. Gorland McBride, District Manager (804) 443-2327

Tidewater Soil and Water Conservation District (Area III)

mission/assistance: The Tidewater Soil and Water Conservation District is an entity of state government. It is a local grassroots organization that seeks to provide practical solutions to soil, water, and other natural resource related problems. To do this, the Tidewater Soil and Water Cons. District provides technical assistance, coordination with other agencies, and promotes environmental awareness throughout the district.

contact: Burton Bland (804) 693-3562

Tri-County/City Soil and Water Conservation District (Area III)

contact: L. Gordon Linkous (703) 373-8592

Virginia Dare Soil and Water Conservation District (Area VI)

mission/assistance: The Virginia Dare Soil and Water Conservation District's mission is to provide and promote leadership in the conservation of natural resources through stewardship and education programs with particular emphasis on water quality. The district offers experience in conservation planning with local farmers, Best Management Practices (agricultural, urban and shoreline) and educational programs.

contact: Julie Bright (804) 427-4775

Virginia Department of Conservation and Recreation, Suffolk, Regional Office, Division of Soil and Water Conservation Area VI

mission/assistance: DCR's mission is to conserve Virginia's natural and recreational resources. The Division of Soil and Water Conservation, Area VI provides education and assistance to landowners and farmers on nutrient management, soil loss, and pesticide management. The regional office also works with farmers on plans for Chesapeake Bay Preservation Act agricultural requirements.

contact: Billie Jean Elmer (804) 925-2468

Virginia Department of Conservation and Recreation, Tappahannock, Regional Office - Division of Soil and Water Conservation Area III

mission/assistance: DCR's mission is to conserve Virginia's natural and recreational resources. The Division of Soil and Water Conservation, Area III provides education and assistance to landowners and farmers on nutrient management, soil loss, and pesticide management. The regional office also works with farmers on plans for Chesapeake Bay Preservation Act agricultural requirements.

contact: Wayne Davis (804) 443-6752

Virginia Department of Conservation and Recreation, Warrenton, Regional Office - Division of Soil and Water Conservation Area II

mission/assistance: DCR's mission is to conserve Virginia's natural and recreational resources. The Division of Soil and Water Conservation, Area II provides education and assistance to landowners and farmers on nutrient management, soil loss, and pesticide management. The regional office also works with farmers on plans for Chesapeake Bay Preservation Act agricultural requirements.

contact: Debbie Cross (703) 347-6420

Virginia Department of Conservation and Recreation (DCR), Division of Soil and Water Conservation, Chesapeake Bay Programs, Bureau of Rivers and Shores

mission/assistance: DCR's mission is to conserve Virginia's natural and recreational resources.

contact: L.S. Button (804) 371-7536

Virginia Department of Conservation and Recreation (DCR), Division of Soil and Water Conservation, Chesapeake Bay Programs, Bureau of Urban Programs

mission/assistance: DCR's mission is to conserve Virginia's natural and recreational resources.

contact: J. Michael Flagg (804) 786-3959

Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, Shoreline Programs Section, Shoreline Erosion Advisory Service

mission/assistance: DCR's mission is to conserve Virginia's natural and recreational resources. Assistance can be provided as education and technical assistance to private properties, government agencies or the general public on shoreline erosion, shoreline erosion control and coastal zone management.

contact: Lee Hill (804) 642-7121

WETLANDS PLANNING, REGULATION, AND CONSERVATION

Accomack County Wetlands Board

contact: David A. Fluhart (804) 787-5721

American Water Works Association

contact: staff (804) 867-9171

Cape Charles Wetlands Board

contact: Richard Barton (804) 331-3259

Charles City County Wetlands Board

contact: John T. Bragg, Jr. (804) 829-9217

Chesapeake Bay Local Assistance Department

mission/assistance: The mission of the Chesapeake Bay Local Assistance Department is to protect the Chesapeake Bay and its tributaries from pollution caused by the use and development of land. To achieve this, the Department will serve the citizens of the Commonwealth by working in partnership with local governments to implement programs that protect and improve water quality, while supporting a healthy economy and other public policy objectives. We provide technical assistance in the areas of regulatory interpretation, nonpoint source pollution control, site design issues, and comprehensive planning for water quality protection.

contact: Scott Kudlas, Chief of Planning Assistance (804) 243-7229

C. Scott Crafton, Chief of Regulatory Assistance (804) 371-7503

(Or use the 800 number: (800) 243-7229)

Chesapeake Wetlands Board

contact: John T. King, III (804) 547-6248

City of Colonial Heights

contact: Vicky Minetree (804) 520-9275

Natural Area Source Book: contacts, resources

Essex County Wetlands Board

contact: James F. Moore (804) 443-4951

Fairfax County Wetlands Board

contact: Connie C. Crawford (703) 324-1210

Fredericksburg Wetlands Board

contact: Jervis Hairston (703) 372-1179

Gloucester County Wetlands Board

contact: David L. Lathrop (804) 693-4040

Hampton Wetlands Board

contact: Patricia Thomas (804) 727-6142

Hopewell Wetlands Board

contact: Milton Marvin (804) 541-2267

Isle of Wight County Wetlands Board

contact: Sandy Whitley (804) 357-3091

James City County Wetlands Board

contact: Jackie White (804) 253-6622

King George Wetlands Board

contact: Kathy Musick (703) 775-7111

King William County Wetlands Board

contact: Dale R. Burton (804) 769-4927

Lancaster County Wetlands Board

contact: William H. Pennell, Jr. (804) 462-5220

Mathews County Wetlands Board

contact: Sherry Ashe (804) 725-5025

Middlesex County Wetlands Board

contact: Michele Mixner DeWitt (804) 758-0500

New Kent County Wetlands Board

contact: R. J. Emerson, Jr. (804) 966-9861

Newport News Wetlands Board

contact: Robert G. Bates (804) 247-8437

Norfolk Wetlands Board

contact: Edwin L. Rosenberg (804) 441-2152

Northampton County Wetlands Board

contact: Milissa S. Burgard (804) 678-5872

Northumberland County Wetlands Board

contact: Kenneth D. Eades (804) 580-8910

Poquoson Wetlands Board

contact: Deborah Vest (804) 868-7151, ext. 25

Portsmouth Wetlands Board

contact: Mike Kelly (804) 393-8836

Prince William County Wetlands Board

contact: Mark Colwell (703) 792-6984

Richmond County Wetlands Board

contact: Bill Duncanson (804) 333-3415

Stafford County Wetlands Board

mission/assistance: The Stafford County Wetlands Board's mission is to preserve and protect wetlands from despoliation and destruction, and to accomodate necessary economic development in a manner consistent with wetlands preservation.

contact: Philip Thompson (703) 659-8668

Suffolk Wetlands Board

contact: Scott Mills (804) 934-3111, ext. 258

Surry County Wetlands Board

contact: Angela Hopkins (804) 294-5210

United States Department of the Interior, Geological Survey, Water Resources Division

mission/assistance: The USGS Water Resources Division's overall mission is to provide hydrologic information and understanding needed for the optimum use and management of the Nation's water resources, for the overall benefit of the people of the United States. The agency is unique among Federal government organizations because it has neither regulatory or developmental authority - it's sole product is information. Assistance in all aspects of hydrology is possible. The USGS can provide matching funds to state agencies and other non-Federal organizations as part of cooperative programs.

contact: Michael Focazio (804) 771-2427

Virginia Beach Wetlands Board

contact: Planning Dept. (804) 427-4131

Virginia Department of Conservation and Recreation (DCR), Division of Soil and Water Conservation, Chesapeake Bay Programs, Bureau of Rivers and Shores

mission/assistance: DCR's mission is to conserve Virginia's natural and recreational resources.

contact: L.S. Button (804) 371-7536

Natural Area Source Book: contacts, resources

Virginia Department of Conservation and Recreation (DCR), Division of Soil and Water Conservation, Chesapeake Bay Programs, Bureau of Urban Programs

mission/assistance: DCR's mission is to conserve Virginia's natural and recreational resources.

contact: J. Michael Flagg (804) 786-3959

Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, Shoreline Programs Section, Shoreline Erosion Advisory Service

mission/assistance: DCR's mission is to conserve Virginia's natural and recreational resources. Assistance can be provided as education and technical assistance to private properties, government agencies or the general public on shoreline erosion, shoreline erosion control and coastal zone management.

contact: Lee Hill (804) 642-7121

Virginia Department of Environmental Quality

mission: Virginia Department of Environmental Quality's mission is to protect the environment of Virginia in order to promote the health and well-being of the Commonwealth's citizens. The Department of Environmental Quality can provide assistance to natural resource managers in the areas of environmental permits, pollution response and remediation, and ambient monitoring data.

contact: Roger K. Everton, Tidewater Regional Office (804) 552-1840

Chet Bigelow, Richmond (804) 527-5061

Virginia Marine Resources Commission (VMRC)

mission/assistance: Virginia Marine Resources Commission holds regulatory jurisdiction over all commercial and sports fishing, marine fish, marine shellfish, and marine organisms in the tidal waters of Virginia. VMRC holds permit jurisdiction on all projects involving use of state owned submerged lands and authority over use or development in vegetated and non-vegetated tidal wetlands and coastal primary sand dunes.

contact: Robert W. Grabb, Chief, Habitat Management Division (804) 247-2250

West Point Wetlands Board

contact: Watson M. Allen (804) 843-3330

Westmoreland County Wetlands Board

contact: Paul Jones (804) 493-0121

Williamsburg Wetlands Board

contact: Jack Hobbs (804) 220-6130

York County Wetlands Board

contact: Cindy Taylor (804) 890-3538

RESOURCE EXPERTS

(* It would be impossible to list ALL resource experts in Virginia, consequently, it should be noted that this list represents only a small portion of local resource experts. Additional resource experts may be found within local governments, state and federal agencies, universities, museums, private organizations and within the general public, as private citizens.)

Ecology:

Gregory M. Capelli, College of William and Mary (804) 221-2224
*aquatic ecology

William H. Moorhead, Department of Conservation and Recreation (804) 786-7951
*field ecologist, community ecology,

James E. Perry, III, Virginia Institute of Marine Science (804) 642-7388
*wetland ecology

Thomas J. Rawinski, Department of Conservation and Recreation (804) 786-7951
*community ecology and classification

Gene M. Silberhorn, Virginia Institute of Marine Science (804) 642-7382
*wetland ecology

Leonard A. Smock, Virginia Commonwealth University (804) 828-1562
*stream ecology, wetlands, water quality

Stuart A. Ware, College of William and Mary (804) 221-2233
*forest ecology

Fauna:

John B. Bazuin, Jr. (703) 308-2285
*birds of Virginia's coastal resource management area

Ruth A. Beck, College of William and Mary (804) 221-2217
*colonial nesting birds, endangered bird species

Charles R. Blem, Virginia Commonwealth University (804) 828-1562
*environmental physiology of vertebrates, acid rain

Dana S. Bradshaw, The Center for Conservation Biology (804) 221-1649
*field biologist, spec. in bird cons. through management and public education, with an emphasis on passerines

Bonnie L. Brown, Virginia Commonwealth University (804) 828-1562
*fish genetics, aquaculture

Natural Area Source Book: contacts, resources

- Mitchell C. Byrd, The Center for Conservation Biology (804) 221-2236
*conservationist, specializing in bird cons. through management and policy, with an emphasis on birds of prey
- Edward E. Clark, Jr., Virginia Wildlife Center (703) 234-WILD
*injured, debilitated wildlife
- Gary Costanzo, Virginia Department of Game and Inland Fisheries (VADGIF) (804) 253-4180
*waterfowl biologist
- John B. Gallegos, Back Bay National Wildlife Refuge (804) 721-2412
*specializing in migratory bird conservation through management
- Greg C. Garman, Virginia Commonwealth University (804) 828-1562
*fish ecology and fisheries management, anadromous fish
- Christopher S. Hobson, Department of Conservation and Recreation (804) 786-7951
*field zoologist, small mammals, reptiles, amphibian, specializing in bat ecology and distribution
- Richard Hoffman, Virginia Museum of Natural History (703) 666-8600
*invertebrate taxonomy, research, education
- John R. Holsinger, Old Dominion University (804) 683-3595
*cave biologist, taxon specific expertise (freshwater isopods and amphipods)
- David N. Karowe, Virginia Commonwealth University (804) 828-1562
*plant-animal interactions, insect ecology
- C. Barry Knisley, Randolph Macon College (804) 752-7254
*tiger beetle, insect conservation and ecology
- Roger L. Mann, Virginia Institute of Marine Science (804) 642-7360
*intertidal oyster reefs, oyster ecology
- Karen L. Mayne, U.S. Fish and Wildlife Service, Virginia Field Office (804) 693-6694
*endangered species
- Joseph F. McCauley, Back Bay National Wildlife Refuge (804) 721-2412
*specializing in migratory bird conservation through refuge management and policy
- Joseph C. Mitchell, University of Richmond (804) 289-8234
*amphibians, reptiles, population and community ecology
- Nancy D. Moncrief, Virginia Museum of Natural History (703) 666-8600
*mammalian genetics, taxonomy, ecology

Natural Area Source Book: contacts, resources

- Richard J. Neves, Virginia Polytechnic Institute and State University (703) 231-5573
*freshwater mollusks and stream ecology
- John F. Pagels, Virginia Commonwealth University (804) 828-1562
*ecology of small mammals, endangered species
- Mike Pinder, Virginia Department of Game and Inland Fisheries (703) 951-6992
*aquatic non-game biologist
- Steven M. Roble, Department of Conservation and Recreation (804) 786-7951
*field zoologist, specializing in rare vertebrates and invertebrates of Virginia
- Robert K. Rose, Old Dominion University (804) 683-3595
*mammals, mammalian ecology, endangered mammals
- Alan H. Savitzky, Old Dominion University (804) 683-3595
*taxon specific expertise (amphibians, reptiles), research, education, canebrake rattlesnake research
- Barbara A. Savitzky, Christopher Newport University (804) 594-7782
*amphibians, reptiles - research, education
- Donald J. Schwab, Virginia Department of Game and Inland Fisheries (804) 934-1577
*wildlife biologist
- Dirk J. Stevenson, Department of Conservation and Recreation (804) 786-7951
*field zoologist, specializing in ecology of reptiles and amphibians
- C. Richard Terman, College of William and Mary (804) 221-2250
*mammalian population ecology, population ecology
- Karen A. Terwilliger, Virginia Department of Game and Inland Fisheries (804) 367-1000
*nongame biologist
- Bryan D. Watts, Center for Conservation Biology (804) 221-2247
*community ecologist, specializing in bird/habitat relationships and landscape ecology, with an emphasis on avian systems relative to dynamic landscapes
- Flora:**
- Allen Belden, Department of Conservation and Recreation (804) 786-7951
*field botanist, rare species identification
- Gary P. Fleming, Department of Conservation and Recreation (804) 786-7951
*field botanist, field ecologist, rare species identification

Natural Area Source Book: contacts, resources

Cecil Frost, North Carolina Department of Agriculture (804) 733-3610
*field botanist, presettlement vegetation of southeastern
Virginia, presettlement fire ecology of Virginia

J. Christopher Ludwig, Department of Conservation and Recreation (804) 786-7951
*field botanist, rare species identification

Lytton J. Musselman, Old Dominion University (804) 683-3595
*botanist, Curator of Herbarium - ODU

John R. Tate, Virginia Department of Agriculture and Consumer Services (804) 786-3515
*endangered plant and insect regulations, listing

Donna M. E. Ware, College of William and Mary (804) 221-2213
*plant systematics, herbarium curator

Thomas F. Wieboldt, Virginia Polytechnic Institute & State University (703) 231-5746
*herbarium curator

Donald R. Young, Virginia Commonwealth University (804) 828-1562
*physiological ecology of barrier island plants

Nancy Van Alstine, Department of Conservation and Recreation (804) 786-7951
*field botanist, rare species identification

Stewardship / Land Management / other

Bryan K. Anderson, Department of Conservation and Recreation (804) 426-7128
*recreation and land management

Lesa S. Berlinghoff, Department of Conservation and Recreation (804) 786-7951
*environmental/project review, rare species tracking

Dennis B. Blanton, Archaeology Section, Virginia Academy of Science (804) 221-2584
*archaeology in Virginia

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Natural Area Source Book: contacts, resources

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Natural Area Source Book: contacts, resources

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Natural Area Source Book: contacts, resources

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IV. Guide to Resource Management Planning for Natural Areas

DEPARTMENT OF CONSERVATION AND RECREATION STATE LANDS RESOURCE MANAGEMENT PLAN GUIDE OUTLINE

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 - B. Policy
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 - c. Historical/cultural use
 - d. Dispersed recreation
 - e. Viewshed
 - f. Natural area preserve
 - g. Zoological/botanical
 - h. Geological
 - i. Wildlife
 - j. Timber
 - k. Agricultural
 - l. Scenic River
 - m. Control limitations and special use
 - ii. Management prescriptions
 - D. Action plans

Virginia Department of Conservation and Recreation

State Lands Resource Management Plan Guide

I. INTRODUCTION

In order to facilitate wise resource management planning, the Department of Conservation and Recreation has established a Land Classification Task Force. The Task Force has developed a land classification system and applied the classifications and use zones to all departmental lands, as stated in DCR Policy #122-1. The DCR Director approved the Task Force classification recommendations in early 1991. The following resource management plan guide, developed by the Land Classification Task Force, is submitted for adoption by the Director according to the terms of DCR Policy #122-2.

The Resource Management Plan Guide is arranged in steps that begin with an extensive inventory and data collection process designed to provide the information on which management scenarios are compared and tested for applicability and impact. Following classification, the site's limitations and opportunities are fully investigated and characterized into zones of suitability and finally into management units where prescriptions will govern appropriate management implementation through action plans. Figure 1 illustrates the steps, process and considerations of the classification system and the development of Resource Management Plans. The guide is broad in context and applicable to the varied purposes for which the state owns and manages land. However, for certain sites or parcels within sites which were acquired for specific purposes or have special use limitations, resource-specific management zone and unit planning may need to be applied as in the management of endangered species or other significant resources.

For the guide to work best, an inter-disciplinary Departmental planning team should be formed to collect data, develop alternatives and analyze the range of potential scenarios under which the property can be managed within compliance of law or regulation. This practice invites a varied perspective and results in the formulation of the most appropriate plan for each property. It is imperative that the Division with lead management responsibility be represented on the planning team, especially when decisions are being made about near term management. This will assure that resource management decisions are within the capabilities and responsibilities of the managing Division. Management implementation should utilize appropriate Departmental expertise and capabilities as well.

The Resource Management Plan Guide that follows is a general, annotated format to aid land managers in developing management plans. It is designed to comprehensively tailor the agency's needs to the land's inherent capability to meet that need, while protecting the natural, cultural, or historic resources and values of the site.

A. Purpose of the Site

Describe the purpose for which the site is being (was) acquired. Usually sites are established for significant biological, physical, cultural, or recreational features. The use of a designation system to identify primary /secondary purposes will help simplify the description process. General categories for consideration are:

1. Natural Resource - primary purpose is conservation and interpretation of unique natural features, including the protection and management of significant biological resources, fisheries, and wildlife.
2. Historic/Cultural Resource - primary purpose is conservation and interpretation of significant cultural resources including historic and prehistoric sites.

3. Recreation Values - primary purpose is to provide a full range of recreational opportunities.
4. Agricultural/Forest Resource - primary purpose is for the production of food and fiber.
5. Special Use - primary purpose is a specific use such as a golf course, environmental education, zoo, museum, prison, etc.

The Department of Conservation and Recreation has developed a specific land classification system for all Departmental lands that refines the five general categories above into units that coincide with the legal mandate of the Department of Conservation and Recreation and that in general can be applied to all Commonwealth lands. This system consists of six primary land classifications with use zones and subzones (see Land Classification report). Each DCR property has been classified according to its primary purpose for establishment and historic management. Further, each classified property is zoned according to compatible uses and the significant resources therein. The classifications approved by the DCR Director are as follows:

- I. State Park
- II. State Natural Area Preserve
- III. State Cultural Resource Area
- IV. State Reserve
- V. State Trail/Greenway
- VI. Special Interest Site

The primary emphasis of management should be consistent with the land classification system. Section Five of this planning outline provides the classification hierarchy, including zones and subzones, as well as a wide range of management prescriptions. Each DCR property will be evaluated using the management guidelines, standards, and prescriptions defined in Sections IV.B and IV.C of this planning outline in order to develop a comprehensive resource management plan for the property.

B. Policy

Appropriate policies, guidelines and authorities affecting the property should be identified and summarized. The Department of Conservation and Recreation will develop and continually revise the standard management policies and guidelines which will provide detailed guidance regarding activities such as prescribed burning, use of herbicides, gypsy moth control, wildlife harvest, etc. When pertinent, these policies and procedures should be addressed in the plan.

II. SITE DESCRIPTION

A. Location

Maps and supporting text should include the following information for each site so as to: 1) identify the site in relation to nearby population centers, 2) identify access routes to the site, and 3) identify governmental boundaries and relationships with relevant agencies or organizations.

B. Demographic Features and Surrounding Land-Use

1. Demographics - Assess the social and economic trends in the region paying particular attention to population growth and recreational trends in the area. Projections of future user needs and interests should be determined.

2. Surrounding Land-use - Describe surrounding land-use and recent trends, mapping different land-use types. Projections of future trends can be obtained from the locality. Comprehensive land-use plans have been developed for many cities and counties throughout the Commonwealth and are valuable sources of information.

The demographic information can be abbreviated for non-recreation sites, however, land-use trends should be discussed in detail for all sites.

C. Boundaries

The exact location of the site's boundaries needs to be determined. An inventory should be done containing: information on the bearings and distances, corner descriptions, line maintenance (whether blazed, painted or cleared), source (deed vs. surveyed) and a line/road category. A boundary map should show the corners numbered along the perimeter of the boundary and correspond to the corners in the inventory. Potential or existing encroachments should be noted.

D. Facilities

An inventory of all man-made features within the site boundaries should be made and each facility accurately mapped. Include any man-made features outside the site which might significantly affect the area. The inventory should include at least the following:

1. Roads - width and length
2. Parking - type and capacity
3. Trails - type and length
4. Buildings - size and function
5. Utilities - water, sewer, solid waste disposal, power, communication
6. Control limitations - rights of way of various kinds, less than fee simple ownership
7. Recreation and facilities - identify all recreational facilities within the site, such as number of campsites, etc.
8. Fencing and barriers - describe and map existing fencing and additional fencing needed. Evaluate existing and potential motorized use and the need to provide barriers to vehicular use of certain areas.

III. RESOURCES

A. Physical and Abiotic Features

This subsection should address the following topics:

1. Topography - describe the relief and aspect of the property. Identify major topographic features such as sinkholes, valley walls, etc. Give the range of elevational changes at the site.
2. Geology - describe the underlying bedrock of the site, formations that lie immediately under the soil material, and any outcrops. Give the geologic age of these deposits. Include geologic maps in an appendix.
3. Soils - describe the different soil types on the property giving depth, slope, permeability, drainage, acidity or alkalinity, fertility and erodibility. Include soil maps in an appendix.
4. Climatic conditions - describe the climate of the area. Mention averages and extremes of temperature and precipitation, seasonal periods of precipitation, fire danger season, prevailing winds, and first and last frost.

5. Hydrologic features - name the major rivers, streams and tributaries that drain the area. Name, locate on a map, and describe the water features and drainage patterns within the site. Describe active processes that may change the character of the area such as sedimentation, eroding gullies, stream bank erosion, etc.

B. Terrestrial and Aquatic Communities

Name, locate and describe terrestrial and aquatic communities within the site. Describe the diversity of floral and faunal species within the area. Include species inventories in the appendices and recommend specific inventories if not available. Those communities which are natural heritage resources should be briefly identified here and described in more detail in the following section of the plan.

C. Natural Heritage Resources

List and locate all natural heritage resources on a U.S.G.S. topographic map or other suitable base map. Include general information about the rare species and/or communities and about the specific occurrences. For each natural heritage resource, develop the following:

1. Physical description, ecological requirements, and population dynamics.
2. Describe the range of habitats occupied within the state.
3. Size and condition of the occurrence.
4. Past and on-going threats that bear on the ecological condition.

D. Cultural Resources

1. Archaeological - identify and survey sites (may not want to show location on public maps).
2. Historical landscapes and structures - identify and describe in detail all existing items located within the site.

E. Recreational Resources

- 1) The range of recreational opportunities should be evaluated using the recreational opportunity spectrum process which includes defining the six opportunity factors.
 - a. Access - all access routes and types are evaluated: roads, trails, cross country/by cars, orvs, horse, foot.
 - b. Non-recreational uses - grazing, mining, timbering, heritage sites.
 - c. On-site management - extent of modification (are there isolated instances of man's modification of the environment or is it well distributed).
 - apparentness of modification (blended with native materials or clearly of off-site origin).
 - complexity of modification (log bridge or complicated engineered structure).
 - facilities (none, some limited basic facilities, or are full service campgrounds, pools, and boating facilities offered).
 - d. Social interaction (none-low-moderate-full) Vary by setting as well as types of acceptable use (i.e. canoe vs. motor boat).
 - e. Acceptability of visitor impacts. (Trampling of vegetation, noise, behavior, etc.) It must be determined in advance what level of impact is appropriate for the type of opportunity being supplied.
 - f. Acceptable regimentation (nature, level and extent of control over recreational use, regs, rules, site design, laws, etc.).

Limitations of size may make provision of many recreation opportunities impractical, but for larger sites, this process will clarify how best to zone areas so that different recreational experiences can be offered. This will also help prevent incompatible uses from degrading recreational resources.

- 2) Aesthetic values of the site should be evaluated. Viewsheds should be classified using a visual quality rating system. Scenic values of the site should be carefully mapped to ensure that proposed management activities will not degrade them. Several tools for mapping visual resources are available and the best approach to use for each site can be determined based on the intended use of the site.

IV. MANAGEMENT PLAN DEVELOPMENT

A. Land Classification

1. Primary Classification

The site should be classified according to the format described in the Departmental Land Classification System. The Definitions used in the classification are as follows:

I. STATE PARK - Property with sufficient acreage which provides developed recreation opportunities and captures the quality of an area's landscape and maintains it. Sites as a whole are to be of statewide or regional significance and provide protection to a natural resource base.

II. STATE NATURAL AREA PRESERVE - Land or water of variable acreage that may offer low intensity public use. The primary purpose of the property is to support rare plant and/or animal species and/or unique natural communities, and it is, therefore, dedicated to ensure their preservation.

III. STATE CULTURAL RESOURCE AREA - Site of variable size managed to demonstrate period of agriculture, historic or formal gardens, and visually or culturally significant buildings, landscape, museums, and significant archaeological sites.

IV. STATE RESERVE - Areas which offer limited opportunity for developed recreation and are managed for multiple use (e.g. timber, open space, and/or agriculture) compatible with the natural environment.

V. STATE TRAIL/GREENWAY - Linear area consisting of Department owned or managed components of the state trails system, scenic river system, By-way System, or other linear corridors.

VI. SPECIAL INTEREST SITE - Area offering limited or specialized public use due to space or configuration. May be used to meet special recreation needs such as water access, trail heads, or scenic views. Special interest sites allow public use with some facility development.

2. Zone Classification

Under each of the six primary classifications there are three major zones, which may be applied to the property. The zones, based on resource analysis, will direct the type of use which may occur on land areas under a major classification.

- i. Non-sensitive (1) - Areas not known to be particularly unique but representative of the local environment. Areas which could be used for preservation or development. Available for public access.
- ii. Sensitive (2) - Areas with sensitive environment, but not necessarily unique statewide. There may be development restrictions which could include: areas highly-susceptible to erosion, steep slopes, wetlands, floodplains and floodways, water bodies, etc.

iii. Preservation Zone (3) - Areas reserved for protection of state significant resources including threatened or endangered plant and animal species or significant cultural resources.

a. Natural - Actual or proposed Natural Area Preserves dedicated to protecting Natural Heritage Resources managed for the habitat of threatened or endangered species or natural communities present on property.

b. Cultural - Areas to protect or preserve State significant Cultural resources.

c. Special - Areas managed for the protection and management of state significant natural resources or cultural areas - can allow for restricted public access.

B. Management Direction/Standards and Guidelines

Long-term goals and specific objectives for the site are described here, including ecologic and programmatic goals. Specific objectives may be listed under each goal.

The general direction for the three zones described in Section IV.A.2 sets minimum levels of protection that must be maintained while achieving the goals and objectives established for the area. These management requirements apply to specific management practices wherever they occur within that zone. The general direction provides guidance on how actions, measures or management practices are to be established for each zone as well as at the site level.

Standards and Guidelines further define acceptable limits within which the general direction is to be implemented. Standards and Guidelines for each zone should address the following topics for consideration.

- Recreation/other public uses
- Hunting, fishing, trapping
- Agriculture
- Timber
- Water
- Minerals and geology
- Soils
- Roads, utilities, access
- Facilities
- Natural Heritage Resources
- Wildfire
- Insects and disease
- Active management of vegetation and wildlife

These considerations may include but are not limited to the above topics. Discuss the existing and needed information regarding each topic and its relation to the site and zone classification.

C. Management Unit Development and Prescriptions

1. Management Unit Development

Management Units are parcels of land receiving a particular prescription and management treatment.

Management units may consist of portions of the site where an individual management prescription or a group of compatible management prescriptions are applied. Most management units are compatible with zone sensitivities but some may be incompatible, and would thus be managed as exceptions. Each unit should be described and mapped. The description should include a statement on the management intent for the unit,

existing resource character, man-made facilities, and any identified concerns. Management units can and should be designed to meet the individual needs of the area for which resource management plans are being developed. Careful consideration must be given to the establishment of these areas and the resource capabilities associated with them.

General categories of management units, based on use, follow:

a. Visitor Services/Concentrated Use Management Unit

All areas which serve concentrations of people would be included, such as day use and overnight use areas, areas used for active land and water activities (not including areas used as hiking trails, for dispersed fishing or hunting, etc.). This unit replaces subscript "d" of the earlier classification scheme.

b. Support/Administrative Management Unit

This area would consist of facilities specific to the operation and maintenance of the parcel, including facilities such as a maintenance shop, water treatment plant, residences, etc. This unit replaces subscript "d" of the earlier classification scheme.

c. Historical and Cultural Use Management Unit

All buildings and grounds which are historic or have historic qualities would be included. Also included would be: areas managed to demonstrate period agriculture, historic or old formal gardens, and visually or culturally significant buildings and landscapes.

d. Dispersed Recreation Management Unit

Contains portions of a site where there is dispersed recreation use. Areas may be managed to provide a variety of dispersed recreation opportunities and experiences, to enhance and interpret the unique natural resources of the area, to develop and administer trail systems.

e. Viewshed Management Unit

Areas which provide scenic quality, natural viewsheds and remoteness. Management activities are limited to those uses that do not affect the existing scenic attributes.

f. Natural Area Preserve Management Unit

Consists of areas which have been dedicated as state natural area preserves. Formal classification of these units can only occur with the approval of the Department Director upon recommendation by the Land Classification Committee and an ecological assessment by the Division of Natural Heritage.

g. Zoological/Botanical Management Unit

Consists of lands requiring special management because of special biological values. Species or communities considered exemplary, sensitive, or rare but which do not meet the criteria for natural area preserve status are included.

h. Geologic Management Unit

Consists of lands protecting fragile fossil or mineral localities and prominent features of the landscape which have high educational and scientific value.

i. Wildlife Management Unit

Contains portions of the site that are managed to maintain or enhance wildlife habitat. A variety of non-motorized dispersed recreation activities may occur in this unit.

j. Timber Management Unit

Consists of portions of the site that are managed for timber through a variety of timber cutting methods. Lands within this management unit provide a range of timber products in as efficient and economic a manner as is consistent with the land classification and overriding objectives for management of the site.

k. Agricultural Management Unit

Consists of portions of the site that are managed for food and fiber. A variety of agricultural practices may be used as long as they are consistent with the land classification and the over-riding objectives for management of the site.

l. Scenic River Management Unit

Areas include state or federally designated scenic rivers and protect the largely primitive/pristine surroundings on the river and within an adequate buffer.

m. Control Limitations and Special Use Management Unit

Any situation or area that occurs within a site where special use permits, management agreements, or easements have been granted or where control is lacking or limited in some respect would be included; such as radio communication towers and stations, public water supply easements, non-site utilities, rights-of-way, inholdings, mining permits, etc. A brief description should be prepared on the special use and extent of any limitations. This unit replaces subscript "m" of the earlier classification scheme.

2. Management Prescriptions

Management prescriptions, following a format of the Standards and Guidelines, should be developed for each management unit. These prescriptions will reflect the direction set in the Management Direction and Standards and Guidelines for the zone and will further refine and direct management on a site-specific basis.

In some instances, site-wide prescriptions (e.g. detailed plant survey needs to be conducted) will cross the boundaries of the management units. The prescriptions should address the identified issues and ensure the unit is contributing to the overall management direction of the site.

D. Action Plans

Actions are considered a set of related tasks leading toward the achievement of an objective. Action plans should enumerate tasks identified through the management prescription planning process and should identify personnel, costs, and schedules for each task.

March 1995

Natural Area Source Book:

V. Bibliography and Pertinent References

Bibliography, pertinent references

Listed below are selected references that may assist land managers, scientists, educators and conservation planners in Virginia's coastal zone. References are grouped under the following broad headings: ecological management and research; economics/planning/public use; exotic /non-native species; fauna; fire; flora; hydrology and water quality; inventory and conservation planning; restoration; soils/substrate.

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I. Appendices

- A. List of Natural Heritage Resources found within Virginia's Coastal Resource Management Area**
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 - NA Registry
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Appendices:

**A. List of Natural Heritage Resources found within
Virginia's Coastal Zone**

Definition of Abbreviations Used on Natural Heritage Resource Lists
of the
Virginia Department of Conservation and Recreation

Natural Heritage Ranks

The following ranks are used by the Virginia Department of Conservation and Recreation to set protection priorities for natural heritage resources. Natural Heritage Resources, or "NHR's," are rare plant and animal species, rare and exemplary natural communities, and significant geologic features. The primary criterion for ranking NHR's is the number of populations or occurrences, i.e. the number of known distinct localities. Also of great importance is the number of individuals in existence at each locality or, if a highly mobile organism (e.g., sea turtles, many birds, and butterflies), the total number of individuals. Other considerations may include the quality of the occurrences, the number of protected occurrences, and threats. However, the emphasis remains on the number of populations or occurrences such that ranks will be an index of known biological rarity.

- S1 Extremely rare; usually 5 or fewer populations or occurrences in the state; or may be a few remaining individuals; often especially vulnerable to extirpation.
- S2 Very rare; usually between 5 and 20 populations or occurrences; or with many individuals in fewer occurrences; often susceptible to becoming extirpated.
- S3 Rare to uncommon; usually between 20 and 100 populations or occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.
- S4 Common; usually >100 populations or occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats.
- S5 Very common; demonstrably secure under present conditions.
- SA Accidental in the state.
- S#B Breeding status of an organism within the state.
- SH Historically known from the state, but not verified for an extended period, usually > 15 years; this rank is used primarily when inventory has been attempted recently.
- S#N Non-breeding status within the state. Usually applied to winter resident species.
- SU Status uncertain, often because of low search effort or cryptic nature of the element.
- SX Apparently extirpated from the state.
- SZ Long distance migrant whose occurrences during migration are too irregular, transitory and/or dispersed to be reliably identified, mapped and protected.

Global ranks are similar, but refer to a species' rarity throughout its total range. Global ranks are denoted with a "G" followed by a character. Note that GA and GN are not used and GX means apparently extinct. A "Q" in a rank indicates that a taxonomic question concerning that species exists. Ranks for subspecies are denoted with a "T". The global and state ranks combined (e.g. G2/S1) give an instant grasp of a species' known rarity.

These ranks should not be interpreted as legal designations.

Federal Legal Status

The Division of Natural Heritage uses the standard abbreviations for Federal endangerment developed by the U.S. Fish and Wildlife Service, Division of Endangered Species and Habitat Conservation.

- | | |
|----------------------------|---|
| LE - Listed Endangered | 3A - Former candidate - presumed extinct |
| LT - Listed Threatened | 3B - Former candidate - not a valid species under current taxonomic understanding |
| PE - Proposed Endangered | 3C - Former candidate - common or well protected |
| PT - Proposed Threatened | NF - no federal legal status |
| C1 - Candidate, category 1 | |
| C2 - Candidate, category 2 | |

State Legal Status

The Division of Natural Heritage uses similar abbreviations for State endangerment.

- | | | |
|------------------------|----------------------------|----------------------|
| LE - Listed Endangered | PE - Proposed Endangered | SC - Special Concern |
| LT - Listed Threatened | PT - Proposed Threatened | |
| C - Candidate | NS - no state legal status | |

For information on the laws pertaining to threatened or endangered species, contact:

U.S. Fish and Wildlife Service for all **FEDERALLY** listed species
Department of Agriculture and Consumer Services Plant Protection Bureau for **STATE** listed plants and insects
Department of Game and Inland Fisheries for all other **STATE** listed animals

DEPARTMENT OF CONSERVATION & RECREATION
DIVISION OF NATURAL HERITAGE

NATURAL HERITAGE RESOURCES OF CZM AREA

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
** AMPHIBIANS					
AMBYSTOMA MABEEI	MABEE'S SALAMANDER	G4	S1		LT
AMBYSTOMA TIGRINUM	TIGER SALAMANDER	G5	S1		LE
BUFO QUERCICUS	OAK TOAD	G5	S1		SC
HYLA GRATIOSA	BARKING TREEFROG	G5	S1		LT
NECTURUS PUNCTATUS	DWARF WATERDOG	G4	SU		
SIREN INTERMEDIA	LESSER SIREN	G5	S2		
SIREN LACERTINA	GREATER SIREN	G5	S2		
** BIRDS					
AIMOPHILA AESTIVALIS	BACHMAN'S SPARROW	G3	S1	C2	LT
AMMODRAMUS CAUDACUTUS	SHARP-TAILED SPARROW	G5	S2		SC
ANAS STREPERA	GADWALL	G5	S2		
ASIO FLAMMEUS	SHORT-EARED OWL	G5	S1		
CASMERODIUS ALBUS	GREAT EGRET	G5	S2B,S4		SC
CERTHIA AMERICANA	BROWN CREEPER	G5	S2S3		SC
CHARADRIUS MELODUS	PIPING PLOVER	G3	S2	LE	LT
CHARADRIUS WILSONIA	WILSON'S PLOVER	G5	S1		LE
CIRCUS CYANEUS	NORTHERN HARRIER	G5	S1S2		SC
EGRETTA CAERULEA	LITTLE BLUE HERON	G5	S2B,S4		SC
EGRETTA THULA	SNOWY EGRET	G5	S2		
EGRETTA TRICOLOR	TRICOLORED HERON	G5	S2B,S4		SC
EUDOCIMUS ALBUS	WHITE IBIS	G5	S1		
FALCO PEREGRINUS	PEREGRINE FALCON	G4	S1	E/SA	LE
GALLINULA CHLOROPUS	COMMON MOORHEN	G5	S1		SC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2S3	LE	LE
IXOBRYCHUS EXILIS	LEAST BITTERN	G5	S2		
LATERALLUS JAMAICENSIS	BLACK RAIL	G4?	SU	C2	
LIMNOTHLYPIS SWAINSONII	SWAINSON'S WARBLER	G4	S2		SC
NYCTANASSA VIOLACEA	YELLOW-CROWNED NIGHT-HERON	G5	S2		SC
NYCTICORAX NYCTICORAX	BLACK-CROWNED NIGHT-HERON	G5	S2S3		
PELECANUS OCCIDENTALIS	BROWN PELICAN	G4	S1B,S4	LE	SC
PHALACROCORAX AURITUS	DOUBLE-CRESTED CORMORANT	G5	S1		
PLEGADIS FALCINELLUS	GLOSSY IBIS	G5	S2		SC
PODILYMBUS PODICEPS	PIED-BILLED GREBE	G5	S2		
PORZANA CAROLINA	SORA	G5	S1		
RALLUS ELEGANS	KING RAIL	G4Q	S2		
RALLUS LIMICOLA	VIRGINIA RAIL	G5	S2		
RYNCHOPS NIGER	BLACK SKIMMER	G5	S2		
STERNA ANTILLARUM	LEAST TERN	G4	S2		SC
STERNA CASPIA	CASPIAN TERN	G5	S1		SC
STERNA MAXIMA	ROYAL TERN	G5	S2		
STERNA NILOTICA	GULL-BILLED TERN	G5	S2		LT
STERNA SANDVICENSIS	SANDWICH TERN	G4	S1		SC

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DIVISION OF NATURAL HERITAGE
NATURAL HERITAGE RESOURCES OF CZM AREA

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
** COMMUNITIES					
DWARF SCRUB					
ESTUARINE BEACH/ShORE					
ESTUARINE HERBACEOUS VEGETATION					
ESTUARINE SCRUB					
EUTROPHIC FOREST					
EUTROPHIC SEASONALLY FLOODED SCRUB					
EUTROPHIC SEMIPERMANENTLY FLOODED FOREST					
LOW HERBACEOUS UPLAND VEGETATION					
LOW HERBACEOUS WETLAND					
MESOTROPHIC FOREST					
MESOTROPHIC SATURATED WOODLAND					
MESOTROPHIC SCRUB					
MESOTROPHIC SEASONALLY FLOODED FOREST					
MESOTROPHIC SEMIPERMANENTLY FLOODED FOREST					
MID-HEIGHT HERBACEOUS UPLAND VEGETATION					
MID-HEIGHT HERBACEOUS WETLAND					
OLIGOTROPHIC FOREST					
OLIGOTROPHIC SATURATED FOREST					
OLIGOTROPHIC SATURATED HERBACEOUS VEGETATION					
OLIGOTROPHIC SATURATED SCRUB					
OLIGOTROPHIC SATURATED WOODLAND					
OLIGOTROPHIC SCRUB					
OLIGOTROPHIC SEASONALLY FLOODED FOREST					
OLIGOTROPHIC SEASONALLY FLOODED HERBACEOUS VEGETATION					
OLIGOTROPHIC SEASONALLY FLOODED WOODLAND					
OLIGOTROPHIC SEMIPERMANENTLY FLOODED FOREST					
OLIGOTROPHIC SEMIPERMANENTLY FLOODED HERBACEOUS VEGETATION					
OLIGOTROPHIC SEMIPERMANENTLY FLOODED SCRUB					
OLIGOTROPHIC SEMIPERMANENTLY FLOODED WOODLAND					
OLIGOTROPHIC WOODLAND					
PERMESOTROPHIC FOREST					
PERMESOTROPHIC WOODLAND					

DEPARTMENT OF CONSERVATION & RECREATION
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NATURAL HERITAGE RESOURCES OF CZM AREA

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
SUBMESOTROPHIC FOREST					
TALL HERBACEOUS WETLAND					
** FISH					
ENNEACANTHUS CHAETODON	BLACKBANDED SUNFISH	G5	S1		LE
ERIMYZON SUCETTA	LAKE CHUBSUCKER	G5	S2		
FUNDULUS LINEOLATUS	LINED TOPMINNOW	G5	S1		
NOTROPIS BUCCATUS	SILVERJAW MINNOW	G5	S3		
NOTROPIS CHALYBAEUS	IRONCOLOR SHINER	G5	S3		
** INVERTEBRATES					
AGELENOPSIS KASTONI	A FUNNEL-WEB SPIDER	G4?	S2		
ALASMIDONTA HETERODON	DWARF WEDGEMUSSEL	G1	S1	LE	LE
ALASMIDONTA VARICOSA	BROOK FLOATER	G3	S1	C2	LE
ANAX LONGIPES	COMET DARNER	G5	S2		
ARGIA BIPUNCTULATA	SEEPAGE DANCER	G4	S2S3		
ARIGOMPHUS VILLOSIPIES	UNICORN CLUBTAIL	G5	S3		
ATLIDES HALESUS	GREAT PURPLE HAIRSTREAK	G5	S2S3		
BARRONOPSIS JEFFERSI	A FUNNEL-WEB SPIDER	G3	S1		
BOTHYNOTUS JOHNSTONI	A MIRID BUG	G3	S1		
BRACHYMESIA GRAVIDA	FOUR-SPOTTED PENNANT	G5	S3		
CALEPHELIS VIRGINIENSIS	LITTLE METALMARK	G4	S2		
CALOPTERYX DIMIDIATA	SPARKLING JEWELWING	G5	S3		
CASTIANEIRA TRILINEATA	A TWO-CLAWED HUNTING SPIDER	G4?	S1		
CELITHEMIS ORNATA	FADED PENNANT	G5	S1		
CHLOROCHROA DISMALIA	DISMAL SWAMP GREEN STINK BUG	GH	SH	C2	C
CICINDELA DORSALIS DORSALIS	NORTHEASTERN BEACH TIGER BEETLE	G4T1T2	S2	LT	C
CICINDELA TRIFASCIATA	A TIGER BEETLE	G5	S1		
CORDULEGASTER ERRONEA	ERRONEOUS BIDDIE	G4	S3		
CORDULEGASTER FASCIATA	SOUTHERN ARROWHEAD SPIKETAIL	G3Q	S1		
CORDULEGASTER OBLIQUA	ARROWHEAD SPIKETAIL	G4	S3		
CTENOTRACHELUS SHERMANI	COMBNECK ASSASSIN BUG	G3	S1		
DRASSYLUS LOUISIANUS	A GNAPHOSID SPIDER	G4?	S1		
ELLIPTIO LANCEOLATA	YELLOW LANCE	G3	S2S3	C2	SC
ENALLAGMA DAECKII	ATTENUATED BLUET	G4	S2		
ENALLAGMA DUBIUM	BURGUNDY BLUET	G5	S2S3		
ENALLAGMA DURUM	BIG BLUET	G5	S3		
ENALLAGMA PALLIDUM	PALE BLUET	G4	S1		
EPITHECA COSTALIS	STRIPE-WINGED BASKETTAIL	G4	S2		
EPITHECA SPINOSA	ROBUST BASKETTAIL	G3G4	S2		C
EUPHYES DUKESI	SCARCE SWAMP SKIPPER	G3	S2		C
GAMMARUS PSEUDOLIMNAEUS	NORTHERN SPRING AMPHIPOD	G5	S3		
GOMPHAESCHNA ANTILOPE	TAPER-TAILED DARNER	G4	S3		
GOMPHAESCHNA FURCILLATA	HARLEQUIN DARNER	G5	S3		
GOMPHUS FRATERNUS	MIDLAND CLUBTAIL	G5	S1		
GOMPHUS ROGERSI	SABLE CLUBTAIL	G4	S1		

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GOMPHUS VENTRICOSUS	SKILLET CLUBTAIL	G3	S1		
HELLUOMORPHOIDES NIGRIPENNIS	A FLAT-HORNED GROUND BEETLE	G4?	S1		
INCISALIA IRUS	FROSTED ELFIN	G4	S2		
ISCHNURA KELICOTTI	LILYPAD FORKTAIL	G5	S2S3		
ISCHNURA PROGNATA	FURTIVE FORKTAIL	G4	S1		
LAMPSILIS CARIOSA	YELLOW LAMPMUSSEL	G4	S2	C2	
LAMPSILIS RADIATA	EASTERN LAMPMUSSEL	G5	S2		SC
LASMIGONA SUBVIRIDIS	ATLANTIC HEELSPLITTER	G3	S2	C2	SC
LESTES CONGENER	SPOTTED SPREADWING	G5	S2		
LIBELLULA EXUSTA	WHITE CORPORAL SKIMMER	G4	S1		
LIBELLULA QUADRIMACULATA	FOUR-SPOTTED SKIMMER	G5	SA		
MACROMIA GEORGINA	GEORGIA RIVER CRUISER	G5	S1S2		
NANNOthemis BELLA	ELFIN SKIMMER	G4	S1		
NASIAESCHNA PENTACANTHA	CYRANO DARNER	G5	S2		
NEHALENNIA INTEGRICOLLIS	SOUTHERN SPRITE	G5	S2		
NEONYMPHA AREOLATA AREOLATA	GEORGIA SATYR	G5T4	S2S3		
PISAUURINA DUBIA	A NURSERY-WEB SPIDER	G4	S1S3		
PLOIARIA CAROLINA	CAROLINA THREAD-LEGGED BUG	G4?	S1		
PLOIARIA HIRTICORNIS	AN ASSASSIN BUG	G3?	S1		
PROBLEMA BULENTA	RARE SKIPPER	G2G3	S1	C2	C
PSEUDAPTINUS TENUICORNIS	A GROUND BEETLE	G7	S1?		
PSEUDOPOLYDESMUS PALUDICOLOUS	A MILLIPEDE	G1	S1		SC
PYCNODERIELLA VIRGINIANA	SEASHORE MIRID BUG	G1?	S1?		
RHYBAXIS SP 1	A PSELAPHID BEETLE	G1?	S1?		
SATYRIUM KINGI	KING'S HAIRSTREAK	G3G4	S2S3		
SOMATOCHLORA FILOSA	FINE-LINED EMERALD	G5	S2		
SOMATOCHLORA PROVOCANS	STRIPED EMERALD	G3G4	S1		
SPEYERIA IDALIA	REGAL FRITILLARY	G3	S1	C2	C
SPHALLOPLANA HOLSINGERI	HOLSINGER'S GROUNDWATER PLANARIAN	GH	SX	3A	
SPHALLOPLANA SUBTILIS	BIGGER'S GROUNDWATER PLANARIAN	GH	SX	3A	
SPHODROS COYLEI	COYLE'S PURSE-WEB SPIDER	G3	S2		
STYGOBROMUS ARAEUS	TIDEWATER INTERSTITIAL AMPHIPOD	G2	S2	C2	SC
STYGOBROMUS INDENTATUS	TIDEWATER AMPHIPOD	G2G3	S2	C2	SC
STYGOBROMUS KENKI	ROCK CREEK GROUNDWATER AMPHIPOD	G1	S1		SC
STYGOBROMUS PHREATICUS	NORTHERN VIRGINIA WELL AMPHIPOD	G2	S1S2		SC
STYGOBROMUS PIZZINII	PIZZINI'S AMPHIPOD	G2	S1S2	C2	SC
STYLURUS LAURAE	LAURA'S CLUBTAIL	G3G4	S2		
STYLURUS PLAGIATUS	RUSSET-TIPPED CLUBTAIL	G5	S3		
TACHOPTERYX THOREYI	GRAY PETALTAIL	G4	S2		
TOMINOTUS COMMUNIS	A BURROWER BUG	G5	S1		
TRAMEA ONUSTA	RED-MANTLED GLIDER	G5	S1		
UTTERBACKIA IMBECILLIS	PAPER POND SHELL	G5	S2		
ZANCLOGNATHA GYPSALIS	A NOCTUID MOTH	GU	SU		
ZANCLOGNATHA SP 2	A NOCTUID MOTH	G4	SU		

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** MAMMALS					
CORYNORHINUS RAFINESQUII	EASTERN BIG-EARED BAT	G3G4	S1	C2	LE
PEROMYSCUS LEUCOPUS EASTI	PUNGO MOUSE	G5T1	S1	C2	
SCIURUS NIGER CINEREUS	DELMARVA PENINSULA FOX SQUIRREL	G5T3	S1	LE	LE
SOREX LONGIROSTRIS FISHERI	DISMAL SWAMP SOUTHEASTERN SHREW	G5T2	S2	LT	LT
SYLVILAGUS FLORIDANUS HITCHENSI	SMITHS ISLAND COTTONTAIL	G5THQ	SH	C2	
SYLVILAGUS PALUSTRIS	MARSH RABBIT	G5	S2S3		SC
** NON-VASCULAR PLANTS					
ORTHOTRICHUM KEEVERAE	KEEVER'S BRISTLE-MOSS	G1	S1	C2	
SPHAGNUM CAROLINIANUM	CAROLINA PEATMOSS	G3	S2		
SPHAGNUM CYCLOPHYLLUM	CIRCULAR-LEAVED PEATMOSS	G3	S1S2		
SPHAGNUM FLEXUOSUM	FLEXUOSE PEATMOSS	G5Q	S1S2		
SPHAGNUM INUNDATUM	INUNDATED PEATMOSS	G3?	S1S2		
SPHAGNUM MACROPHYLLUM VAR MACROPHYLLUM	LARGE-LEAF PEATMOSS	G3G4T3	S2		
SPHAGNUM MOLLE	SOFT PEATMOSS	G4	S2		
SPHAGNUM PORTORICENSE	PUERTO RICO PEATMOSS	G5	S1S2		
SPHAGNUM STRICTUM	STRAIGHT PEATMOSS	G5	S2		
SPHAGNUM SUBTILE	DELICATE PEATMOSS	G5?Q	S1S2		
SPHAGNUM TORREYANUM	TORREY'S PEATMOSS	G3G4	S2		
SPHAGNUM TRINITENSE	TRINIDAD PEATMOSS	G4	S2S3		
** OTHER					
BALD EAGLE ROOST					
BIRD NESTING COLONY					
CHAMPION TREE					
SIGNIFICANT GREAT BLUE HERON COLONY		G3G5	S2		
** REPTILES					
CARETTA CARETTA	LOGGERHEAD SEA TURTLE	G3	S1B,S2	LT	LT
CLEMMYS INSCULPTA	WOOD TURTLE	G4	S2		LT
CROTALUS HORRIDUS ATRICAUDATUS	CANEBRAKE RATTLESNAKE	G5TUQ	S1		LE
DEIROCHELYS RETICULARIA	CHICKEN TURTLE	G5	S1		LE
OPHISAURUS VENTRALIS	EASTERN GLASS LIZARD	G5	S1		LT
REGINA RIGIDA	GLOSSY CRAYFISH SNAKE	G5	S1		
TANTILLA CORONATA	SOUTHEASTERN CROWNED SNAKE	G5	S2		
** VASCULAR PLANTS					
AESCHYNOMENE VIRGINICA	SENSITIVE JOINT-VETCH	G2	S2	LT	C
AGALINIS AURICULATA	EARLEAF FOXGLOVE	G2	S1	C2	C
ALETRIS AUREA	GOLDEN COLICROOT	G5	S1		
AMARANTHUS PUMILUS	SEABEACH PIGWEED	G2	SH	LT	
ANDROPOGON MOHRII	MOHR BLUESTEM	G4?	SH		
ARABIS SHORTII	SHORT'S ROCKCRESS	G5	S2		
ARENARIA LANUGINOSA	A SANDWORT	G5	SH		
ARNOGLOSSUM MUEHLENBERGII	GREAT INDIAN-PLANTAIN	G4	S2		
ASCLEPIAS LONGIFOLIA	LONG-LEAF MILKWEED	G4G5	S1		
ASCLEPIAS RUBRA	RED MILKWEED	G4G5	S2S3		

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ASIMINA PARVIFLORA	DWARF PAW-PAW	G5	S2S3		
ASTER ERICOIDES	WHITE HEATH ASTER	G5	S2		
ASTER PUNICEUS VAR ELLIOTTII	ELLIOTT'S ASTER	G5T3T4	S1		
BACOPA CAROLINIANA	CAROLINA WATER-HYSSOP	G4G5	SH		
BACOPA INNOMINATA	TROPICAL WATER-HYSSOP	G5	S2		LE
BACOPA ROTUNDIFOLIA	ROUND-LEAVED WATER-HYSSOP	G5	S1		
BOLTONIA CAROLINIANA	CAROLINA BOLTONIA	G4?	S2		
BROMUS CILIATUS	FRINGED BROME	G5	S1		
BUCHNERA AMERICANA	BLUE-HEARTS	G5?	S1		
CABOMBA CAROLINIANA	CAROLINA FANWORT	G5	S1		
CACALIA SUAVEOLENS	SWEET-SCENTED INDIAN-PLANTAIN	G3	S2		
CALOPOGON PALLIDUS	PALE GRASS-PINK	G4G5	SH		
CALYCANTHUS FLORIDUS VAR FLORIDUS	SWEET-SHRUB	G5T4	S2?		
CAREX CAREYANA	CAREY'S SEDGE	G5	S2		
CAREX DECOMPOSITA	EPIPHYTIC SEDGE	G3G4	S1	3C	C
CAREX LACUSTRIS	LAKE-BANK SEDGE	G5	S1		
CAREX LUPULIFORMIS	FALSE HOP SEDGE	G3?	S1		
CAREX RENIFORMIS	RENIFORM SEDGE	G4?	S1		
CAREX SILICEA	SEA-BEACH SEDGE	G5	S1		
CAREX STRAMINEA	STRAW SEDGE	G5	S1		
CAREX STRIATA	A SEDGE	G4	S2		
CAREX VESTITA	A SEDGE	G5	S2		
CARPHEPHORUS BELLIDIFOLIUS	SANDY-WOODS CHAFFHEAD	G4	S1		
CARPHEPHORUS TOMENTOSUS	WOOLY CHAFFHEAD	G4	S1		
CASSIA FASCICULATA VAR MACROSPERMA	MARSH SENNA	G5T2	S2	C2	
CENCHRUS CAROLINIANUS	COAST SANDBUR	G5	S2		
CHAMAECYPARIS THYOIDES	ATLANTIC WHITE CEDAR	G4	S2		
CHAMAESYCE BOMBENSIS	SOUTHERN BEACH SPURGE	G4G5	S2		
CHELONE CUTHBERTII	CUTHBERT TURTLEHEAD	G3	S2		
CHELONE OBLIQUA	RED TURTLEHEAD	G4	S1		
CHRYSOPSIS GOSSYPINA	COTTONY GOLDEN-ASTER	G5	S1		
CICUTA BULBIFERA	BULB-BEARING WATER-HEMLOCK	G5	SH		
CIRSIIUM REPANDUM	COASTAL-PLAIN THISTLE	G5	SH		
CIRSIIUM VIRGINIANUM	VIRGINIA THISTLE	G3G4	S2		
CLADIUM MARISCUS SSP JAMAICENSE	SAWGRASS	G5T5	S1		
CLEISTES DIVARICATA	SPREADING POGONIA	G4	S1		
CORNUS AMOMUM SSP OBLIQUA	SILKY DOGWOOD	G5T?	S2?		
CORNUS SERICEA SSP SERICEA	RED-OSIER DOGWOOD	G5T5	S1		
CRATAEGUS AESTIVALIS	MAY HAWTHORN	G5	S1		
CRATAEGUS CALPODENDRON	PEAR HAWTHORN	G5	S1		
CROTALARIA ROTUNDIFOLIA	PROSTRATE RATTLE-BOX	G5	SH		
CTENIUM AROMATICUM	TOOTHACHE GRASS	G5	S1		
CUSCUTA CEPHALANTHI	BUTTON-BUSH DODDER	G5	S1?		
CUSCUTA CORYLI	HAZEL DODDER	G5	S2?		

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CUSCUTA INDECORA	PRETTY DODDER	G5	S2?		
CUSCUTA POLYGONORUM	SMARTWEED DODDER	G5	S2?		
CYPERUS DENTATUS	TOOTHED SEDGE	G4	S1		C
CYPERUS DIANDRUS	UMBRELLA FLATSEDGE	G5	SH		
CYPERUS ENGELMANNII	ENGELMANN'S UMBRELLA-SEdge	G4Q	SH		
DESMODIUM OCHROLEUCUM	CREAMFLOWER TICK-TREFOIL	G2G3	S1		
DESMODIUM SESSILIFOLIUM	SESSILE-LEAF TICK-TREFOIL	G5	S2		
DESMODIUM STRICTUM	PINELAND TICK-TREFOIL	G4	S2		
DESMODIUM TENUIFOLIUM	SLIM-LEAF TICK-TREFOIL	G3G4	S1		
DIARRHENA OBOVATA	A BEAKGRAIN	G7	S1		
DICLIPTERA BRACHIATA	WILD MUDWORT	G5	S1		
DIDIPLAS DIANDRA	WATER-PURSLANE	G5	S1		
DIGITARIA COGNATA	MOUNTAIN HAIRGRASS	G5	S1S2		
ELATINE MINIMA	SMALL WATER-WORT	G5	S1		
ELEOCHARIS BALDWINII	BALDWIN SPIKERUSH	G4G5	S1		
ELEOCHARIS ELLIPTICA	SLENDER SPIKERUSH	G5	S1S2		
ELEOCHARIS EQUISETOIDES	HORSE-TAIL SPIKERUSH	G4	S1		
ELEOCHARIS HALOPHILA	SALT-MARSH SPIKERUSH	G4	S1		
ELEOCHARIS MELANOCARPA	BLACK-FRUITED SPIKERUSH	G4	S2		C
ELEOCHARIS RADICANS	ROOTED SPIKERUSH	G5	SH		
ELEOCHARIS ROBBINSII	ROBBINS SPIKERUSH	G4G5	S1		C
ELEOCHARIS TENUIS VAR VERRUCOSA	SLENDER SPIKERUSH	G5T3T5	S1		
ELEOCHARIS TRICOSTATA	THREE-ANGLE SPIKERUSH	G4	S1		
ELEOCHARIS VIVIPARA	VIVIPAROUS SPIKERUSH	G5	S1		
ERIGERON VERNUS	WHITE-TOP FLEABANE	G5	S2		
ERIOCAULON AQUATICUM	WHITE BUTTONS	G5	S1		C
ERIOCAULON DECANGULARE	TEN-ANGLE PIPEWORT	G5	S2		
ERIOCAULON PARKERI	PARKER'S PIPEWORT	G3	S2S3	3C	
ERYTHRONIUM ALBIDUM	WHITE TROUT-LILY	G5	S2		
EUPATORIUM GLAUDESCENS	WEDGE-LEAF THOROUGHWORT	G5	SH		
EUPATORIUM INCARNATUM	PINK THOROUGHWORT	G5	S2		
FILIPENDULA RUBRA	QUEEN-OF-THE-PRAIRIE	G4G5	S2		
FIMBRISTYLIS CAROLINIANA	CAROLINA FIMBRISTYLIS	G4	S2		
FIMBRISTYLIS PERPUSILLA	HARPER'S FIMBRISTYLIS	G2G3	S1	C2	LE
GALIUM HISPIDULUM	COAST BEDSTRAW	G5	S2		
GENTIANA AUTUMNALIS	PINE-BARREN GENTIAN	G3	S1	3C	
GEUM LACINIATUM	ROUGH AVENS	G5	S2		
GLYCERIA GRANDIS	AMERICAN MANNAGRASS	G5	S1		
GYMNOPOGON BREVIFOLIUS	BROAD-LEAVED BEARDGRASS	G5	S1		
HELENIUM BREVIFOLIUM	SHORTLEAF SNEEZEWEED	G4?	S2		
HELIANTHEMUM BICKNELLII	PLAINS FROSTWEED	G5	S1		
HELIANTHEMUM PROPINQUUM	LOW FROSTWEED	G4	S1		
HELIANTHUS OCCIDENTALIS	MCDOWELL SUNFLOWER	G5	S1		
HELIOTROPIUM CURASSAVICUM	SEASIDE HELIOTROPE	G5	S1		

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HELONIAS BULLATA	SWAMP-PINK	G3	S2S3	LT	LE
HONCKENYA PEPLOIDES	SEA-BEACH SANDWORT	G5	S1		
HOTTONIA INFLATA	FEATHERFOIL	G4	S2		
HYDROCOTYLE BONARIENSIS	COASTAL-PLAIN PENNY-WORT	G5	S1?		
HYPERICUM SETOSUM	A ST. JOHN'S-WORT	G4G5	S1		
HYPOXIS SESSILIS	LONG'S YELLOW STAR-GRASS	G4	SH		
ILEX CORIACEA	BAY-GAIL HOLLY	G5	S1		
IRENE RHIZOMATOSA	EASTERN BLOODLEAF	G5	S1S2		
IRIS VERSICOLOR	BLUEFLAG	G5	S2		
ISOPYRUM BITERNATUM	FALSE RUE-ANEMONE	G5	S1		
ISOTRIA MEDEOLOIDES	SMALL WHORLED POGONIA	G2G3	S2	LT	LE
IVA IMBRICATA	SEA-COAST MARSH-ELDER	G5?	S1S2		
JUNCUS ABORTIVUS	PINE-BARREN RUSH	G4G5	S1		C
JUNCUS ARTICULATUS	JOINTED RUSH	G5	S2		
JUNCUS CAESARIENSIS	NEW JERSEY RUSH	G2	S2	C2	C
JUNCUS ELLIOTTII	BOG RUSH	G4G5	S1S2		
JUNCUS GRISCOMII	GRISCOM'S RUSH	GHQ	SH		
JUNCUS MEGACEPHALUS	BIG-HEAD RUSH	G4G5	S2		
JUNCUS PELOCARPUS	BROWN-FRUITED RUSH	G5	S1		
JUNIPERUS COMMUNIS	GROUND JUNIPER	G5	S1		
JUSTICIA OVATA	OVATE WATER-WILLOW	G5	S2S3		
LACHNANTHES CAROLIANA	CAROLINA REDROOT	G4	SH		
LACHNOCAULON ANCEPS	BOG-BUTTONS	G5	S2		
LATHYRUS PALUSTRIS	VETCHLING	G5	S1		
LEERSIA HEXANDRA	CLUB-HEAD CUTGRASS	G5	SH		
LEPTOCHLOA FASCICULARIS VAR MARITIMA	LONG-AWNED SPRANGLETOP	G5T3	S2S3		
LILAEOPSIS CAROLINENSIS	CAROLINA LILAEOPSIS	G3	S1S2	3C	C
LILIUM CATESBAEI	SOUTHERN RED LILY	G4	S1		
LIPARIS LOESELII	LOESEL'S TWAYBLADE	G5	S2		
LIPOCARPHA MACULATA	A LIPOCARPHA	G5	S1		
LIPOCARPHA MICRANTHA	DWARF BULRUSH	G4	S1		
LITHOSPERMUM CAROLINIENSE	GOLDEN PUCCOON	G4G5	S1		
LOBELIA ELONGATA	ELONGATED LOBELIA	G4G5	S1		
LUDWIGIA ALATA	WINGED SEEDBOX	G3G4	S1		
LUDWIGIA BREVIPES	LONG BEACH SEEDBOX	G4G5	S2S3		
LUDWIGIA PILOSA	HAIRY SEEDBOX	G5	SH		
LUDWIGIA RAVENII	RAVEN'S SEEDBOX	G2?	S1		
LUDWIGIA REPENS	CREEPING SEEDBOX	G5	S1		
LUDWIGIA SPHAEROCARPA	GLOBE-FRUITED SEEDBOX	G5	S2		
LUDWIGIA VIRGATA	SAVANNA SEEDBOX	G5	SH		
LYCOPODIELLA CAROLINIANA VAR CAROLINIANA	SLENDER CLUBMOSS	G5T4	S1		
LYCOPODIELLA INUNDATA	NORTHERN BOG CLUBMOSS	G5	S1		

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LYSIMACHIA RADICANS	TRAILING LOOSESTRIFE	G4G5	S1		
LYTHRUM ALATUM VAR ALATUM	WINGED LOOSESTRIFE	G5T5	S2		
LYTHRUM ALATUM VAR LANCEOLATUM	LANCE-LEAVED LOOSESTRIFE	G5T?	SH		
MATELEA DECIPIENS	OLD-FIELD MILKVINE	G5	S1		
MATTEUCCIA STRUTHIOPTERIS	OSTRICH FERN	G5	S1		
MICRANTHEMUM MICRANTHEMOIDES	NUTTALL'S MICRANTHEMUM	GH	SH	C2*	C
MICRANTHEMUM UMBROSUM	SHADE MUDFLOWER	G5	S1		
MIMOSA QUADRIVALVIS VAR ANGUSTATA	LITTLE-LEAF SENSITIVE-BRIARS	G5T5	S2		
MITREOLA PETIOLATA	LAX HORNPOD	G5	S1		
MONOTROPSIS ODORATA	SWEET PINE SAP	G3	S2S3	C2	
MYRIOPHYLLUM HUMILE	LOW WATER-MILFOIL	G5	S1		
NUPHAR LUTEA SSP SAGITTIFOLIA	YELLOW COWLILY	G5T2	S1		
NYMPHOIDES AQUATICA	BIG FLOATING-HEART	G5	S1		
OLDENLANDIA BOSCHII	BOSC'S BLUET	G5	S1		
ONOSMODIUM VIRGINIANUM	VIRGINIA FALSE-GROMWELL	G4	S2		
OPHIOGLOSSUM PETIOLATUM	LONGSTEM ADDER'S-TONGUE	G5	SH		
ORTHILIA SECUNDA	ONE-SIDED WINTERGREEN	G5	SH		
OSMANTHUS AMERICANUS	WILD OLIVE	G5	S1		
PANICUM HEMITOMON	MAIDENCANE	G5?	S1		
PARONYCHIA VIRGINICA VAR VIRGINICA	YELLOW NAILWORT	G4T1Q	S1S2	C2	C
PASPALUM DISSECTUM	WALTER PASPALUM	G4?	S1		
PASPALUM DISTICHUM	JOINT PASPALUM	G5	S1		
PASPALUM PRAECOX	EARLY PASPALUM	G4	SH		
PENSTEMON HIRSUTUS	HAIRY BEARDTONGUE	G4	S2		
PHACELIA RANUNCULACEA	BLUE SCORPION-WEED	G4	S1		
PHLOX PILOSA	DOWNY PHLOX	G5	S2		
PHYLA NODIFLORA	COMMON FROG-FRUIT	G5	S1		
PHYSALIS WALTERI	STICKY GROUND-CHERRY	G4	S2		
PHYSOSTEGIA LEPTOPHYLLA	SLENDER-LEAVED DRAGON-HEAD	G4G5	S2	3C	
PINUS PALUSTRIS	LONG-LEAF PINE	G4G5	S1		
PLANTAGO CORDATA	HEART-LEAVED PLANTAIN	G4	SH	3C	
PLANTAGO MARITIMA	SEASIDE PLANTAIN	G5	S1		
PLATANThERA BLEPHARIGLOTTIS	WHITE-FRIDGE ORCHIS	G4G5	S2		C
POLYGONELLA POLYGAMA	OCTOBER-FLOWER	G4	S1		
POLYGONUM GLAUCUM	SEA-BEACH KNOTWEED	G3	S1		
POTAMOGETON OAKESIANUS	OAKES PONDWEED	G4	S2		C
POTAMOGETON SPIRILLUS	SPIRAL PONDWEED	G5	S1		
PUCCINELLIA FASCICULATA	SALT MARSH GOOSEGRASS	GU	S1		
PYCNANTHEMUM MONOTRICHUM	A MOUNTAIN-MINT	GHQ	S1?	3A	
PYCNANTHEMUM TORREI	TORREY MOUNTAIN-MINT	G2	S2?		
PYROLA ELLIPTICA	SHINLEAF	G5	S2		
PYXIDANTHERA BARBULATA	FLOWERING PIXIE-MOSS	G4	S1		C
QUERCUS HEMISPHERICA	DARLINGTON'S OAK	G5	S1		
QUERCUS INCANA	BLUE JACK OAK	G5	S2		

DEPARTMENT OF CONSERVATION & RECREATION
DIVISION OF NATURAL HERITAGE

NATURAL HERITAGE RESOURCES OF CZM AREA

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
QUERCUS LAEVIS	TURKEY OAK	G5	S2		
QUERCUS PRINOIDES	DWARF CHINOJAPIN OAK	G5	S2		
QUERCUS SHUMARDII	SHUMARD'S OAK	G5	S2		
RANUNCULUS AQUATILIS	WHITE WATER BUTTERCUP	G5	S1		
RANUNCULUS HEDERACEUS	LONG-STALKED CROWFOOT	G5	SH		
RANUNCULUS LAXICAILIS	MISSISSIPPI BUTTERCUP	G5?	S1		
RANUNCULUS LONGIROSTRIS	WHITE WATER CROW-FOOT	G5	S1		
RHEXIA PETIOLATA	CILIATE MEADOWBEAUTY	G3G5	S1		
RHODODENDRON ARBORESCENS	SMOOTH AZALEA	G4G5	S2		
RHYNCHOSPORA ALBA	WHITE BEAKRUSH	G5	S2		
RHYNCHOSPORA COLORATA	WHITE-TOPPED SEDGE	G5	S1		
RHYNCHOSPORA DEBILIS	SAVANNAH BEAKRUSH	G4?	S1		
RHYNCHOSPORA FASCICULARIS	FASCICULATE BEAKRUSH	G5	S2		
RHYNCHOSPORA NITENS	SHORT-BEAKED BALDRUSH	G4	S1		
RHYNCHOSPORA OLIGANTHA	FEW-FLOWERED BEAKRUSH	G4	S1		
RHYNCHOSPORA PALLIDA	PALE BEAKRUSH	G3	SH		
RHYNCHOSPORA PERPLEXA	A BEAKRUSH	G5	S1		
RHYNCHOSPORA SCIRPOIDES	LONG-BEAKED BALDRUSH	G4	S1		
RORIPPA SESSILIFLORA	STALKLESS YELLOWCRESS	G5	S1		
ROSA SETIGERA	PRAIRIE ROSE	G5	S1		
RUBUS IDAEUS	COMMON RED RASPBERRY	G5	S2		
RUDBECKIA HELIOPSISIDIS	SUN-FACING CONEFLOWER	G2	S1	C2	C
SABATIA CALYCINA	COAST ROSE-GENTIAN	G3G5	S1S2		
SABATIA CAMPANULATA	SLENDER MARSH PINK	G5	S2		
SABATIA DIFFORMIS	TWO-FORMED PINK	G4G5	S1		
SABATIA KENNEDYANA	PLYMOUTH GENTIAN	G3	S1		
SACCHARUM BREVIBARBE	SHORT-BEARD PLUMEGRASS	G3G5	S1		
SAGITTARIA ENGELMANNIANA	ENGELMANN ARROWHEAD	G5?	SH		
SALIX EXIGUA	SANDBAR WILLOW	G5	S1		
SANICULA TRIFOLIATA	LARGE-FRUITED SANICLE	G4	S2		
SARRACENIA FLAVA	YELLOW PITCHER-PLANT	G4G5	S1		C
SARRACENIA PURPUREA	NORTHERN PITCHER-PLANT	G5	S2S3		
SCIRPUS ACUTUS	HARD-STEMMED BULRUSH	G5	S1		
SCIRPUS ETUBERCULATUS	CANBY'S BULRUSH	G3G4	SH		
SCIRPUS FLUVIATILIS	RIVER BULRUSH	G5	S1		
SCIRPUS SUBTERMINALIS	WATER BULRUSH	G4G5	S1S2		
SCLERIA MINOR	SLENDER NUTRUSH	G4	S2		
SCLEROLEPIS UNIFLORA	ONE-FLOWER SCLEROLEPIS	G4	S1		
SCUTELLARIA INCANA	HOARY SKULLCAP	G5	S1		
SEYMERIA CASSIOIDES	SEYMERIA	G5	S1S2		
SIDA HERMAPHRODITA	VIRGINIA MALLOW	G2	S1	3C	
SILENE NIVEA	SNOWY CAMPION	G4?	S1		
SISYRINCHIUM ALBIDUM	WHITE BLUE-EYED-GRASS	G5?	S2		
SOLIDAGO LATISSIMIFOLIA	ELLIOTT GOLDENROD	G5	S1		

DEPARTMENT OF CONSERVATION & RECREATION
DIVISION OF NATURAL HERITAGE

NATURAL HERITAGE RESOURCES OF CZM AREA

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
SOLIDAGO RACEMOSA	STICKY GOLDENROD	G4?	S1		
SOLIDAGO RIGIDA	STIFF GOLDENROD	G5	S2		
SOLIDAGO RUPESTRIS	ROCK GOLDENROD	G4?	S1		
SOLIDAGO STRICTA	WANDLIKE GOLDENROD	G5	S2		
SOLIDAGO TORTIFOLIA	A GOLDENROD	G4G5	S1		
SOLIDAGO ULIGINOSA	BOG GOLDENROD	G4G5	S2		
SPARGANIUM ANDROCLADUM	BRANCHING BURREED	G4G5	S1		
SPARTINA PECTINATA	FRESHWATER CORDGRASS	G5	S2		
SPHENOPHOLIS FILIFORMIS	LONG-LEAF WEDGESCALE	G4?	S1		
SPIRANTHES OCHROLEUCA	YELLOW NODDING LADIES'-TRESSES	G4	S2		
STACHYS PALUSTRIS	MARSH HEDGE-NETTLE	G5	S1		
STEINCHISMA HIANS	GAPING PANIC GRASS	G5	S1		
STEWARTIA MALACHODENDRON	SILKY CAMELLIA	G4	S2		
STEWARTIA OVATA	MOUNTAIN CAMELLIA	G4	S2		
STIPULICIDA SETACEA	PINELAND SCALY-PINK	G4G5	S1		
TALINUM MENGESII	MENGE'S FLAME-FLOWER	G3	S1		3C
TETRAGONOTHECA HELIANTHOIDES	PINELAND SQUAREHEAD	G5	S1		
THALICTRUM MACROSTYLUM	PIEDMONT MEADOW-RUE	G4?	S1		
THELYPTERIS SIMULATA	BOG FERN	G5	S1S2		
TILLANDSIA USNEOIDES	SPANISH MOSS	G5	S2		
TOFIELDIA RACEMOSA	COASTAL FALSE-ASPHODEL	G5	S1		
TRIADENUM FRASERI	FRASER'S MARSH ST. JOHN'S-WORT	G4G5	S1		
TRIDENS STRICTUS	LONG-SPIKE FLUFF-GRASS	G5	S1		
TRIFOLIUM REFLEXUM	BUFFALO CLOVER	G5	S1		
TRILLIUM PUSILLUM VAR VIRGINIANUM	VIRGINIA LEAST TRILLIUM	G3T2	S2		C2
TRIPHORA TRIANTHOPHORA	NODDING POGONIA	G4	S1		
UTRICULARIA FIBROSA	FIBROUS BLADDERWORT	G4G5	S1		
UTRICULARIA JUNCEA	SOUTHERN BLADDERWORT	G5	S2		
UTRICULARIA MACRORHIZA	GREATER BLADDERWORT	G5	S2S3		
UTRICULARIA OLIVACEA	MINUTE BLADDERWORT	G4	S1		
UTRICULARIA PURPUREA	PURPLE BLADDERWORT	G5	S2		
VACCINIUM CRASSIFOLIUM	CREEPING BLUEBERRY	G4G5	S1		
VACCINIUM MACROCARPON	LARGE CRANBERRY	G4	S2		
VALERIANA PAUCIFLORA	VALERIAN	G4G5	S2		
VERBENA SCABRA	SANDPAPER VERVAIN	G5	S2		
VIOLA ESCULENTA	SALAD VIOLET	G4G5	S1		
VITIS RUPESTRIS	SAND GRAPE	G3?	S2		
WISTERIA FRUTESCENS	AMERICAN WISTERIA	G5	S2		
WOLFFIA COLUMBIANA	COLUMBIA WATER-MEAL	G5	S1		
XYRIS CAROLINIANA	CAROLINA YELLOW-EYED-GRASS	G4G5	S1		
XYRIS FIMBRIATA	FRINGED YELLOW-EYED-GRASS	G5	SH		
XYRIS LAXIFOLIA VAR IRIDIFOLIA	A YELLOW-EYED-GRASS	G3G5T?	S1		
ZENOBI A PULVERULENTA	DUSTY ZENOBI A	G4?	S1		
ZIGADENUS GLABERRIMUS	LARGE-FLOWERED CAMASS	G5	S1		

DEPARTMENT OF CONSERVATION & RECREATION
DIVISION OF NATURAL HERITAGE

NATURAL HERITAGE RESOURCES OF CZM AREA

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
ZORNIA BRACTEATA	VIPERINA	G5?	S1		

461 Records Processed

Appendices:

B. Natural Heritage Fact Sheets

Natural Area Protection

Natural Area Dedication

What is Natural Area Dedication?

Natural Area Dedication is a conservation option available to landowners of highly significant natural areas. This is the strongest form of protection available for the preservation of our natural heritage resources. Dedication is the placement of natural areas, both privately and publicly owned, into Virginia's Natural Area Preserve System. The landowner retains ownership and transfer rights of the land, while voluntarily restricting those land uses which are incompatible with the conservation needs of the natural area.

How are Lands Dedicated?

A landowner who is interested in dedicating his/her land should contact the Virginia Department of Conservation and Recreation (DCR). If the property qualifies for Natural Area Dedication, the landowner and DCR will write a legal document known as the Instrument of Dedication. The Instrument of Dedication will address factors such as a legal description of the area to be dedicated, the conservation objectives for the site, the extent of public use desired, and the land use(s) that will be restricted. The director of DCR has the sole authority to approve an Instrument of Dedication. Upon approval, the director and the landowner will sign the document, which places the land into Virginia's Natural Area Preserve System. The document will be recorded with the deed of the property thereby ensuring permanent protection of the natural area against conversion to inappropriate uses.

What Lands Qualify for Natural Area Dedication?

Only the most significant natural areas in Virginia are considered for

Natural Area Dedication. To be eligible, a property must include one or more of these natural values:

- ◆ habitat for rare, threatened or endangered plant or animal species;
- ◆ rare or state significant natural communities;
- ◆ rare or state significant geologic sites.

How are Dedicated Lands Managed?

Once natural areas are placed into Virginia's Natural Area Preserve System, DCR stewardship staff assists landowners in developing management plans and conducting management activities. Natural Area Preserves are managed to retain their natural character and to ensure the long-term survival of natural heritage resources. A variety of management techniques is used to preserve native ecological systems, rare or vanishing flora and fauna, and significant geological features. Management may in-



clude repairing trails, posting boundaries, studying hydrology, controlling invasive species, conducting prescribed burns and restoring damaged natural communities.

What are the Advantages to Natural Area Dedication?

Through Natural Area Dedication, a landowner is rewarded with the pride of contributing to a statewide conservation effort. Dedication provides the landowner with the

- more

Natural Area Protection


Natural Area Dedication

satisfaction of preserving an area of beauty for the enjoyment of future generations. In addition, landowners may receive financial

incentives for dedicating their land. Examples include possible reduced assessment for real estate purposes, reduction of federal es-

tate and Virginia inheritance taxes, and a charitable deduction for state and federal income tax purposes.

For more information, contact the Department of Conservation and Recreation.

 **DCR**
Department of Conservation & Recreation
CONSERVING VIRGINIA'S NATURAL AND RECREATIONAL RESOURCES
1500 East Main Street, Suite 312
Richmond, VA 23219



This fact sheet was funded in part by the Department of Environmental Quality's Coastal Resources Management Program through Grant #NA270Z0312-01 of the National Oceanic and Atmospheric Administration Office of Coastal Resource Management Act of 1972 as amended.

Natural Area Protection

● Natural Area Management Agreements

What is a Natural Area Management Agreement?

A Natural Area Management Agreement is a written contract between a landowner and the Department of Conservation and Recreation (DCR) designed to achieve specific conservation objectives. The agreement will clearly state the management plan for the land and the duration of the agreement. The management objectives will be determined according to the conservation goals of the landowner and DCR, and will be based on the specific management needs of natural heritage resources. The contract will be valid after it is signed by the landowner and the director of DCR. This is a legal agreement which may be cancelled by either party following a 30 day notice.

How are Natural Areas Managed?

Natural areas are managed to retain their natural character and to ensure the long-term survival of natural heritage resources. Various management techniques are used to preserve rare or vanishing flora and fauna, natural environments and ecosystems.

Each natural area requires a management plan written to address the characteristics and conditions of the area. An important aspect of natural area management planning is determining what land-uses are compatible within a given area. This planning requires a thorough analysis of the ecological values of a particular site along with the economic and social influences. The landowner and DCR agree on compatible land-use practices and incorporate those in a plan.

Many natural areas require active management to ensure rare natural communities and species flourish. DCR natural area stewards provide technical expertise in developing management plans and implementing ecological management projects. Common ecologi-

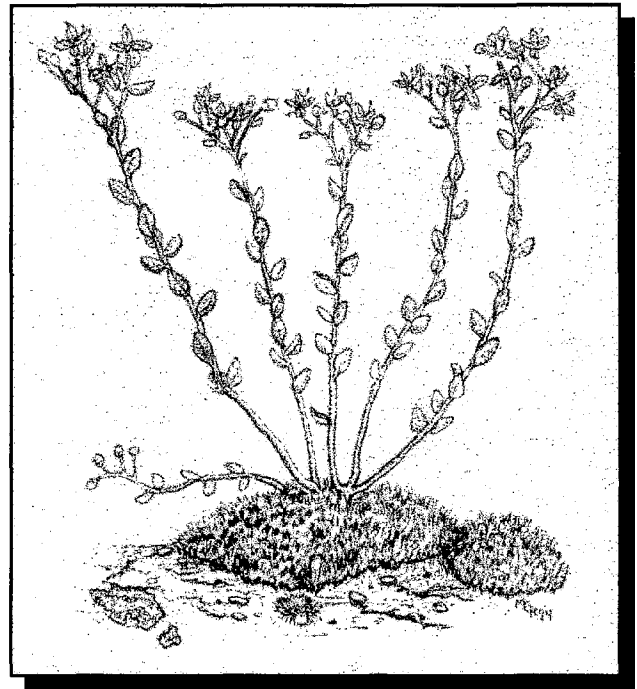
cal management techniques include prescribed burning, invasive species control, biological monitoring and hydrologic restoration.

What Lands Qualify for a Natural Area Management Agreement?

Natural Area Management Agreements are designed to preserve the commonwealth's most significant natural areas.

To be eligible, a property must include one or more of these natural values:

- ◆ habitat of rare, threatened or endangered plant and animal species,
- ◆ rare or state significant natural communities,
- ◆ rare or state significant geologic sites.



Why Should a Landowner Consider a Natural Area Management Agreement?

In selecting this protection option, the landowner is rewarded with the pride of contributing to the conservation of Virginia's natural heritage. If the landowner wishes, the professional staff of DCR can offer management advice or assistance. The DCR stewardship staff is available to develop and implement plans for various management procedures such as pre-

Natural Area Protection

Natural Area Management Agreements


scribed burning, control of invasive species, establishment of vegetative buffers, and hydrologic restoration. In addition, our stewardship staff will monitor the condition of the resources for the landowner as well as provide the owner with information about the resources on his/her land.

Who Should Consider a Natural Area Management Agreement?

A Natural Area Management Agreement is an option available to conserve natural areas on either publicly or privately owned land. This option is well suited for the

landowner who wishes to retain ownership of land and takes pride in the natural features of his/her property. It is best suited for landowners who are committed to conserving natural heritage resources.

For more information, contact the Department of Conservation and Recreation.

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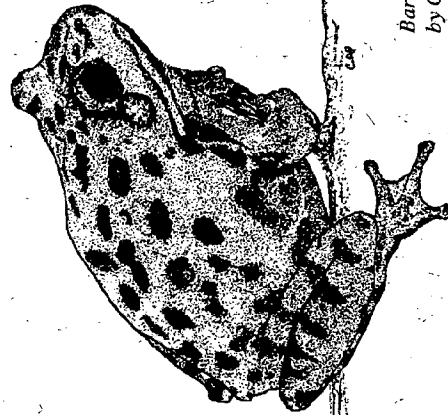
What commitment does the landowner make?

Landowners who participate in Virginia's Registry of Natural Areas commit to the following:

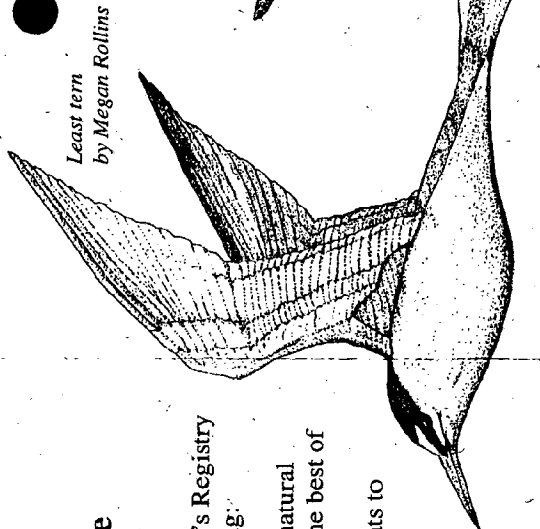
- 1) to voluntarily preserve and protect natural heritage resources on their land to the best of their ability;
- 2) to notify DCR of any potential threats to these resources, such as pollution, clearing of land, etc.;
- 3) to notify DCR of any intent to sell or transfer ownership of the property.

What recognition does the landowner receive for this commitment?

In honor of the voluntary commitment to protect the natural area, the landowner will receive a plaque recognizing the land for its significant features and the owner for their stewardship commitment.



Barking treefrog
by Chris Pague



Least tern
by Megan Rollins



Gray's lily
by Megan Rollins

Does the owner receive any financial incentives?

No. However, there are other protection methods available, such as conservation easements and natural area dedication which could offer tax incentives.

Is management assistance available to the owner of a registered area?

Yes. DCR will provide management assistance at the landowner's request.

For additional information, contact:



Department of Conservation & Recreation
CONSERVING VIRGINIA'S NATURAL AND RECREATIONAL RESOURCES

Division of Natural Heritage
1500 E. Main Street, Suite 312
Richmond, VA 23219
(804) 786-7951

Virginia

REGISTRY

OF

NATURAL

AREAS



Cypress swamp
by Ali Wieboldt

Virginia's Natural Heritage...

Virginia is a state of extraordinary natural diversity—from the sandy beaches of the Atlantic Ocean and the Chesapeake Bay, across the gentle hills of the Piedmont and the Shenandoah Valley, to the mountains of the western highlands. Residents of the Commonwealth take great pride in the beauty of our natural heritage. More than 2,400 native species of plants, 848 vertebrate animals and 30,000 invertebrate animals interact with Virginia's rocks, soils, and water to form unique natural communities and ecosystems. However, some species and ecosystems which flourished in Virginia's past are very threatened

Milbourn leather flower
by Ali Wieboldt



today. As the human population increases, so does the conversion of natural lands to other uses. As a result, the land certain plants and animals depend upon for survival may be permanently damaged or destroyed. Fortunately, we are learning to take precautions and property owners are acting voluntarily to safeguard the best that remains of our natural world.

What is the Registry of Natural Areas?

Virginia's Registry of Natural Areas is a program developed to encourage voluntary conservation of significant lands in private and public ownership. Our staff has identified more than 900 natural areas throughout the Commonwealth which serve as habitat for our natural heritage resources. Landowners of these sites play a crucial role in the conservation of such lands and in turn the future survival of the natural communities and rare species they support. Species are often lost simply because the landowner is unaware of its existence and needs. By informing and recognizing the landowners of these significant natural areas, the Registry of Natural Areas Program reduces the chance that these resources may be

unknowingly destroyed. The program is operated by the Virginia Department of Conservation and Recreation (DCR), an agency devoted to the identification and protection of the Commonwealth's most significant natural areas.

What areas qualify for the registry?

To be eligible for placement on the registry, a property

must support significant natural heritage resources for Virginia, such as:

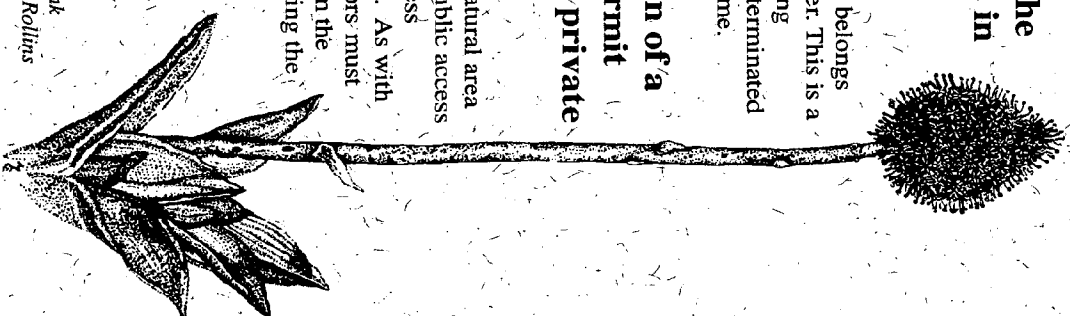
- 1) habitat for rare, threatened, or endangered plants or animals.
- 2) rare or state significant natural communities.
- 3) significant geologic landmarks.

What say does the landowner have in the registration process?

The decision to register belongs entirely to the landowner. This is a voluntary and nonbinding agreement that may be terminated by either party at any time.

Does registration of a natural area permit public access to private property?

No. Registration of a natural area provides no rights of public access to private property unless requested by the owner. As with any private land, visitors must receive permission from the landowner before entering the property. Locations of registered natural areas are not publicized unless the owner so desires.



Swamp pink
by Megan Rollins

Natural Area Stewardship

Ecological Management

Natural areas encompass a wide range of environments and support a rich diversity of flora and fauna. From its tidal salt marshes of the coast to its boreal forests of the mountains, Virginia has been described as an ecological crossroads of national significance.

Virginia's Department of Conservation and Recreation (DCR) acquires, dedicates and manages natural areas of statewide significance. The Natural Area Preserve System focuses on preserving lands so that rare natural communities and species may flourish. In addition, DCR advises other levels of government and private owners about managing natural areas. Following acquisition, DCR faces the even greater challenge of natural area stewardship. *Stewardship is the long-term management of land to maintain its natural resources and inherent natural beauty.* DCR stewardship is a combination of property and ecological management. On any natural area preserve, one may find staff and volunteers searching for rare plants, posting boundary signs, repairing trails or studying hydrology.

Ecological management is focused on maintaining and enhancing the natu-



Restoration

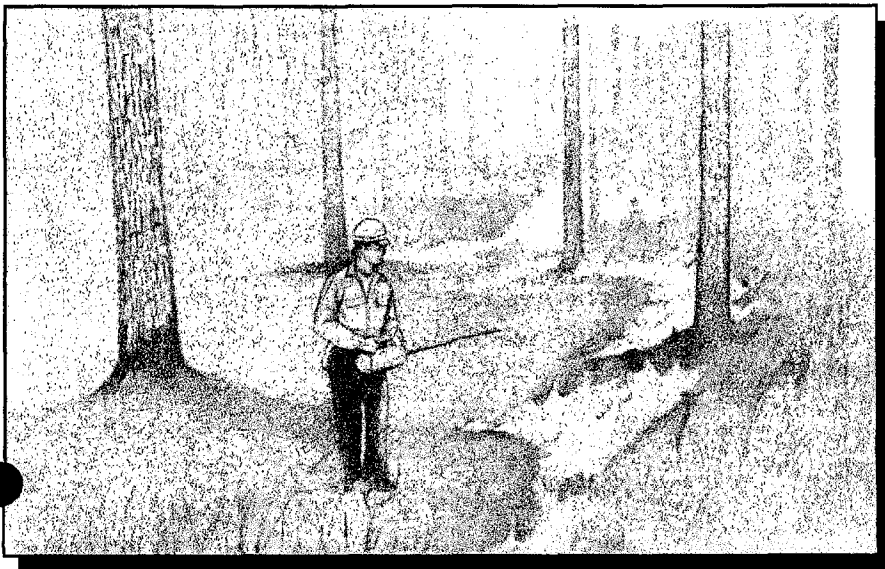
ral values of land to conserve biological diversity. Land protection alone, however, does little to preserve the character of a natural area if impacts such as the introduction of invasive alien plants, or hydrologic disturbances are not also addressed. With continuing alteration of the land by human activity, many ecosystems have become fragmented or reduced to isolated islands surrounded by agricultural fields or developed areas. Ecological management is the key to successful stewardship and can be sub-divided into five general categories: conservation planning, restora-

tion, prescribed management, research and monitoring.

Conservation Planning is the analysis of the ecological, economic and social features of land which provides the scientific foundation for conservation of natural areas. Conservation planning starts well before a natural area is acquired. Planning boundaries are set which delineate ecologically sensitive areas where land-use activities should be carefully managed to ensure that they are compatible with conservation goals for natural resources. Well designed natural area preserves encompass those ecological features necessary for the survival of native flora and fauna, and are planned to permit the best possible management by DCR stewards.

Restoration activities are implemented in an attempt to return disturbed land or vegetation to its original condition. Fundamental environmental processes critical to ecosystem functioning include water and nutrient cycling, erosion, herbivory, and natural disturbances such as floods and fire. Restoration techniques reinstate or replicate environmental processes to aid the return of an ecosystem to its original state.

◆ **Habitat restoration** involves the return of specific habitat features to the environment, and the introduction of specific plants and animals to ensure



Prescribed burning

Natural Area Stewardship

Ecological Management

habitation of the area by native species. Habitat restoration may also involve the removal of invasive or non-native species from the natural area.

◆ **Hydrologic restoration** allows for the natural flow of water through a wetland or along a waterway. Maintaining or restoring the movement and chemistry of water encourages certain plants and animals to inhabit an area. Hydrologic restoration may involve the removal of obstructions to water flow, plugging of ditches, or remedial work to improve water quality.

Prescribed Management maintains or enhances environmental conditions of an area. Through management activities such as prescribed burning and invasive species control, natural area stewards protect and rejuvenate natural vegetation. This enhances habitat conditions for many rare species and preserves the integrity of rare communities.

◆ **Prescribed burning** is the carefully planned and controlled use of fire to accomplish a management goal. Many natural areas in Virginia such as longleaf pine-turkey oak sandhills and grassy savannahs contain plants that are dependent on or benefit from regular fires to enhance seed germination and make space and nutrients available for new growth.

◆ **Invasive species** represent a serious threat to natural areas. Often these species have no natural enemies or controls to curb their growth and dispersal; they can easily outcompete native species for

needed resources such as space, sunlight and food.

Once established in disturbed areas, they advance steadily into natural areas and can be difficult to remove. A variety of control methods, such as mechanical removal and the use of environmentally safe herbicides, are used by natural area stewards to control invasive species.

Research is important to the long-term preservation of a natural area for identifying the environmental conditions necessary to support a particular community or species of interest. Information to guide management of rare species or communities is often lacking. Research aimed at understanding the natural history, biology and population dynamics of a rare species or how an ecosystem functions is essential for planning effective management.

Monitoring is a multi-faceted tool used by natural area stewards to assess the ecological condition of an area. It is used to document the trends of natural communities and rare species. It can also help determine if the natural processes essential to their continued existence are occurring. Monitoring is not limited to assessing only the condition




Monitoring

of plant and animal species; air, water, land and pollution are other components of the environment that must be monitored for effective resource management. Monitoring activities also inform natural area stewards if management activities have been successful in fulfilling their goals. Information obtained through monitoring can be used to further refine and enhance current management practices.

Effective stewardship of Virginia's natural areas is dependant on the dedication of a variety of people. Land managers, resource experts, conservation planners and private landowners all contribute to sound ecological management practices. Volunteers also contribute significantly to preserving natural areas through assistance with monitoring, prescribed management and restoration projects. If you are interested in learning more about Virginia's natural area preserves and ecological management programs, contact the Department of Conservation and Recreation at (804) 786-7951.

For more information, contact the Department of Conservation and Recreation.


Department of Conservation & Recreation
CONSERVING VIRGINIA'S NATURAL AND RECREATIONAL RESOURCES
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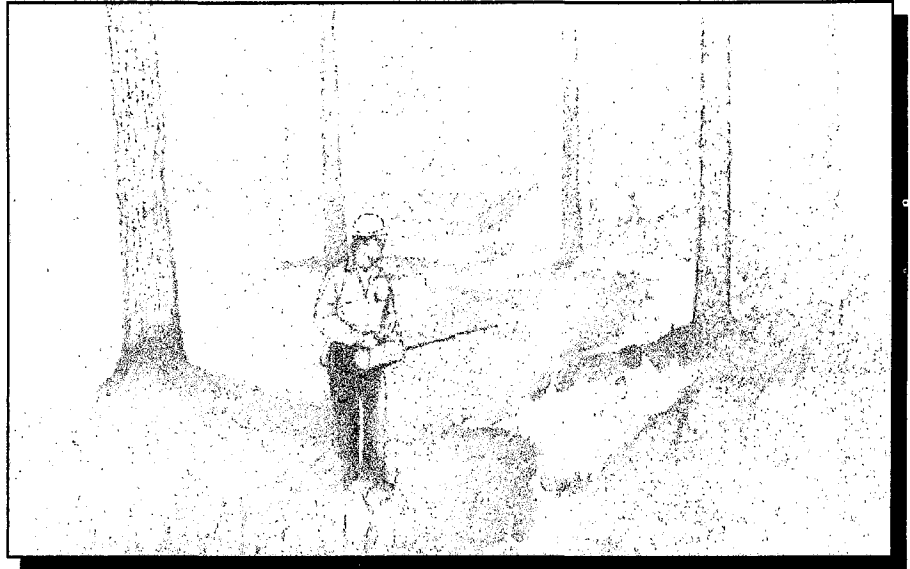
Natural Areas Management Techniques

Fire and Natural Areas: An Overview

Whether caused by lightning or the hand of man, fire has been a part of the natural world for centuries. In Virginia, prior to European settlement, American Indians intentionally set fires for hunting, protection, warfare, agriculture, vegetation management and food gathering. On flat terrain, fires would burn over large areas until some natural barrier or rainfall event was encountered. Today unrestrained fires represent a hazard to public safety and property, but the benefits of carefully prescribed and controlled fire can still be realized. Fire is recognized as a cost-effective land management tool by silviculturalists, wildlife managers, and natural area managers. Prescribed burning is practiced today using skillful methods and rigid safety specifications.

Prescribed burning is the intentional use of fire in a particular time and place, under established conditions and specifications, to accomplish a biological or resource management goal. The Virginia Department of Conservation and Recreation (DCR) uses prescribed burning when this practice benefits particular fire-dependant natural communities and species. Secondary benefits derived from regular burning include opening aesthetically pleasing landscapes, impressive displays of wildflowers, greater numbers and enhanced visibility of wildlife, and a profusion of blueberries, huckleberries and raspberries.

Vegetation succession is the natural process by which one type of vegetation is replaced by another leading toward increased biomass and vegetation structure. The end point of succession is referred to as the climax, or steady-state condition in which the community is more or less self-sustaining. Throughout much of Virginia, succession left unchecked would result in dense, closed canopy forest. Maintaining open, early-successional types of vegetation such as prairie, savannah, woodland and glade, and the species dependant on these communities, necessitates fire management as a means of *setting back* the process of succession.




Prescribed Burning

Fire contributes to maintaining Virginia's natural heritage in so many ways. Entire forest types such as longleaf pine forest, pitch pine forest and table mountain pine forest are created and perpetuated by fire. The grassy savannahs created by fire provide the necessary breeding habitat for rare Bachman's sparrows and other forms of wildlife. Prairie vegetation still exists in Virginia largely because of frequent accidental fires along railroad tracks. Lastly, there are more than 100 rare plant species which either depend

on or benefit from fire. Fire liberates the rare plants from competing woody vegetation and sometimes enhances seed germination.

The case of the Virginia-endemic Peter's Mountain Mallow is dramatically illustrative. Just four naturally established individual plants remained until an experimental burn was conducted at the site. *Four hundred* new plants appeared after the fire. Prescribed burn management will likely rescue this species from the brink of extinction.

For more information, contact the Department of Conservation and Recreation.


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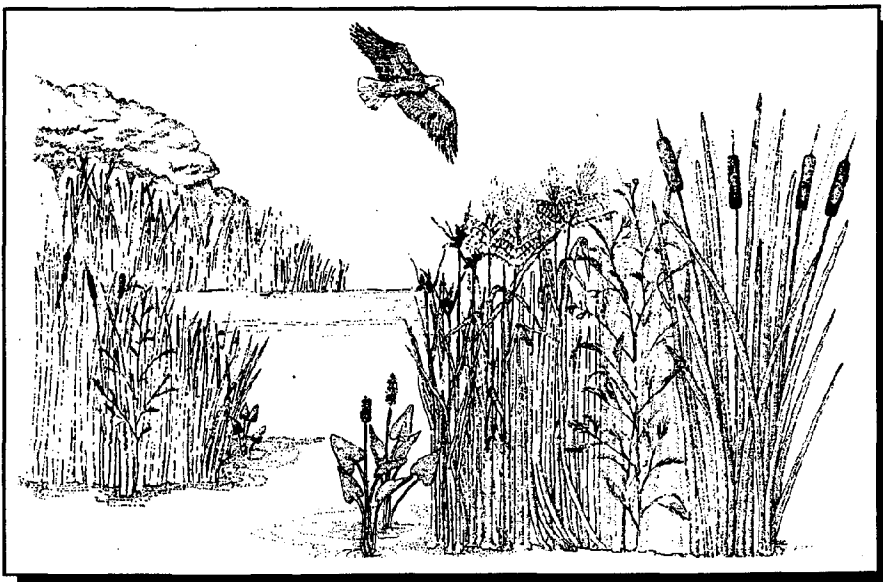
Natural Heritage Resources Fact Sheet

Virginia's Rare Natural Environments

Conserving Virginia's Natural Environments: Why?

The natural environments of Virginia contain a wondrous array of indigenous plants and animals, and each environment has its distinctive community of species. The term *community* refers to species that occur together. It has the same meaning in the natural world as in our own lives. Just like humans, each organism plays an important role in the functioning of the whole system, and all parts are interdependent.

Over thousands of years, the species in each community have evolved life history strategies which enable them to survive within a specific *niche*. This process does not take place in a vacuum—the strategies adopted by one species influence the direction taken by others. Nor has it stopped. Like a river that flows through time and across space, a natural community undergoes constant change yet retains its essential characteristics. For instance, all plants growing in the area compete with one another for the available light, moisture and nutrients. Plants which die are soon replaced by others. Also, just like humans do, plants change their environment as they live in it. They can affect fertility by contributing organic matter to the soil, thereby influencing the robustness and density of the vegetation. When a community is disturbed by damaging wind, fire, floods or human activity, opportunistic plants are the first to recolonize the area, but these are soon replaced by larger or more long-lived species. This is a process known as vegetation succession. Many plants depend on insects for pollination, while other plants have evolved strategies which utilize birds and mammals as effective agents of seed dispersal. Some plants produce seeds within sweet, fragrant, or brightly colored fruit. When consumed by birds and mammals, these seeds remain viable and are expelled



The freshwater marsh community pictured above is but one of Virginia's rare natural environments.

in nutrient-rich droppings at a new location. Other plants have seeds which hitchhike across the landscape by clinging to animal fur or even human clothing.

Animals, in turn, are absolutely dependent on plants. Among the 30,000 insect species in Virginia, many feed on a single plant species or genus. Animals either consume plants directly, or prey on the herbivores (plant eaters), or prey upon the predators of the herbivores, thus forming complex food chains.

As you travel across Virginia, you can recognize the major types of natural communities by the plants and animals that live there. The shifting sands of coastal dunes support windswept meadows of beach-grass and sea oats. Towering cypress trees

dominate the silty river bottoms on the coastal plain, while alder and sycamore prevail alongside mountain streams. Often the vegetation reflects the underlying geology. Mountain slopes dominated by pine and oak usually indicate acidic soils derived from shale and sandstone, while sugar maple, tulip-tree, basswood, and buckeye often indicate limestone. Elevation has a dramatic effect on vegetation, as any visitor to Mount Rogers can attest.

Specific communities are classified based on the dominant or characteristic species present. Examples are *chestnut oak–mountain laurel forest* and *longleaf pine–turkey oak woodland*. By naming community types, we communicate information more effectively and can inventory

Virginia's Rare Natural Environments

Conserving Virginia's Natural Environments: Why?

the best examples of each. Some community types are widespread because conditions which created them are present over large areas. Other communities are restricted to just a few areas simply because the natural environments upon which they depend are so rare on the landscape. However, in too many cases the rarity of a community is the result of human activity. Through thoughtless deeds and actions, we have altered and even destroyed biologically diverse communities.

Scientists recognize that the destruction of natural communities endangers us as well as the natural world. We, too, depend on the *ecosystem services* which natural communities provide: Vegetation filters and holds water to ensure a clean and reliable water source, removes carbon dioxide from the atmosphere and restores oxygen, holds soil and


helps maintain fertility, and can provide renewable forest products and forage for livestock. To a great extent, the economy of coastal Virginia is directly dependent on a productive and uncontaminated Chesapeake Bay ecosystem.

Often overlooked but vitally important is the role played by beneficial insects which pollinate fruit trees and many crops, and keep pest organisms in check at virtually no cost to society. Natural lands also help maintain the *balance of nature*, primarily through the maintenance of predator-prey relationships: Hawks and owls which nest in forests control harmful rodents in adjacent farm land; bats residing in a cave consume vast numbers of mosquitoes on warm summer nights.

Unfortunately, many of these ecosystem services are not fully appre-

ciated and valued in real dollar terms. Consequently, too many important areas are being destroyed before their overall biological and societal values have been determined. It may come as a surprise to learn that species entirely new to science are continually being discovered in Virginia. Examples include many insect species and a plant called running glade clover discovered in Lee County. By protecting the best remaining natural environments, we most assuredly will be protecting a host of poorly known species whose role in the ecosystem and whose value to human society have yet to be determined. We have to be encouraged, however, that Virginians care deeply about preserving our beautiful land, and that our citizens will strive to ensure that the natural heritage we inherited is passed on to future generations.

For more information, contact the Department of Conservation and Recreation.

 **DCR**
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Natural Heritage Resources Fact Sheet

Virginia's Rare Natural Environments

Bald Cypress-Water Tupelo Swamp

Description

The cypress-tupelo swamps bordering the rivers of southeastern Virginia contain some of the largest and most impressive trees found anywhere in the eastern United States. These swamps are the wettest and deepest forested wetlands which form in low-lying areas, commonly in depressions, floodplains, abandoned river channels, or sloughs following a major river channel. Although normally separated from a river, much of the land is flooded year-round with the water standing up to several feet deep. In Virginia, bald cypress and water tupelo are often found together in these deepwater swamps and have developed a variety of adaptations for surviving flooded conditions. Bald cypress trees produce the familiar *knees* which rise above the water helping to stabilize the tree in the soft soil and possibly supplying oxygen to the roots. Water tupelo produces very wide, buttressed lower trunks for stability in the standing water. Regular flooding of the swamp produces oxygen-poor soils and drives the subsequent complex processes that are used to extract and circulate nutrients and oxygen within the community.



Bald Cypress-Water Tupelo Community

Distribution

Bald cypress-water tupelo swamps are most common in the southeastern coastal plain where extensive river systems and flat topography combine to create prolonged flooding. In Virginia, large, undisturbed tracts of bald cypress-water tupelo swamps are rare and occur mainly in the southeastern part of the state where bald cypress approaches its northern range limit. The Blackwater River in Isle of Wight and Southampton counties supports several examples of old growth bald cypress-water tupelo swamps. Other southeastern

rivers supporting this type of vegetation include the Nottaway and Meherrin rivers, and Fontaine Creek.

Flora and Fauna

Bald cypress and water tupelo trees grow to more than 150 feet tall with a trunk diameter of six feet. Older ones are estimated to be at least 600 years old. These swamps are host to many other wetland plant and animal species. Typical shrubs and herbs associated with the bald cypress-water tupelo swamps of Virginia include water ash, buttonbush, swamp

rose, Virginia willow, lizards tail and cardinal flower. On the water's surface, duckweed and water fern are common members of the swamp community.

The swamps are also an important habitat for many species of waterfowl. Wood duck and mallards breed here, as do several heron species, warblers and other songbirds. These swamps contain abundant crayfish and mussels, and are also home to beavers, muskrat and numerous other animal species.

Virginia's Rare Natural Environments

Bald Cypress-Water Tupelo Swamp

Values

Besides hosting important plant and animal species, bald cypress-water tupelo swamp forests have several important functions. Primarily these low swamps act as a sink for floodwater and protect higher areas during floods. They have a role in filtering river water and removing sediments. They also function in erosion control and groundwater recharge. Finally, these swamp forests are a pleasing wetland environment for recreation and enjoyment of nature.

Threats:

The primary threat to bald cypress-water tupelo swamps in Virginia is disruption of the habitat by human activity. Logging has encroached on some of the unprotected old growth forests along the Blackwater River. Continued thinning of the trees could alter the light levels of the forest, increase

the frequency of blow-downs, and encourage the spread of invasive or alien species. Ditching, draining, or damming a swamp can result in the disruption of water flow and sediment cycling of the swamp. Road and bridge construction or improvement activities should be carefully planned and monitored to minimize impacts in swamps. Preserving the natural flow of the river is critical to the long-term maintenance of these forests.

Protection

Bald cypress-water tupelo forests are irreplaceable natural heritage resources in Virginia. Logging operations and development activities should be planned to minimize impacts on these wetland forests. Protection from water contamination, pollution, and disturbance will also require a comprehensive planning approach.

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Natural Heritage Resources Fact Sheet

● Virginia's Rare Natural Environments

Pocosins

Description

Pocosins are a rare natural environment characterized by peaty soils and heath-like vegetation. Often tucked between coastal freshwater marshes and deepwater swamp forests of the Atlantic coastal plain, pocosins are one of Virginia's rarest wetlands. A high water table, an abundance of sphagnum moss, and the slow decay of dead vegetation contribute to the deep peat and acidic soils of these areas. These conditions, along with nutrient poor soils and frequent fires, are common features of pocosin communities. The landscape of these wetlands grades from shrubby, low pocosins dominated by a dense layer of low heath vegetation and occasional open herbaceous areas to higher forested pocosins with sparse to dense small trees and shrubs. This low vegetation is maintained by fire, the high water table, and the naturally low nutrient levels in the soil. Some species, such as Atlantic white cedar, depend on fire to curb the growth of competing vegetation and stimulate seed germination. Presently, habitat loss and a less frequent incidence of fire has altered the structure of pocosins and may threaten their continued existence in Virginia.



Pocosin Community

Distribution

Pocosins are found throughout the Atlantic coastal plain from southeastern Virginia to northern Florida, and west to Mississippi. In Virginia, pocosins have never been common, but have historically been found in the Great Dismal Swamp and along the lower Blackwater, Northwest, North Landing, and Nottaway rivers. Currently, they are limited in Virginia to remnant communities in the Great Dismal Swamp and along the North Landing River.

Flora and Fauna

In Virginia, red maple, Atlantic white

cedar and pond pine are the dominant tree species in high pocosins. Atlantic white cedar is a rare and valuable lumber tree which has been steadily declining across much of its range because of harvesting, fire suppression, and habitat loss. A dense understory of fetterbush, sheep laurel, inkberry, sweet bay and red bay grows beneath the trees. Throughout the pocosin is a thick tangle of greenbrier vine, and Virginia chain fern is the dominant herbaceous plant. Several rare plants can be found in these wetlands, especially as *islands* or openings in the lowest pocosins. These rarities in-

clude spreading pogonia and Walter's sedge.

Few surveys have been conducted on the animal species found in pocosins, however, rare butterflies such as Hessel's hairstreak are known to inhabit these wetlands.

Threats

It has been estimated that less than 30 percent of pocosin communities throughout the Atlantic coastal plain remain in their natural condition. Virginia has fared even worse with only 17 percent of its pocosins remaining today. Ditching, draining and peat mining have taken their toll on

Virginia's Rare Natural Environments

Pocosins

water and nutrient cycling in these environments, and the suppression of fire has allowed the growth of woody species to go unchecked. Atlantic white cedar is in need of protection and thrives in pocosin habitats. The return of this rare and valuable tree will depend on protecting and managing its wetland home.

Protection

The pocosins along the North Landing River are protected by The Nature Conservancy and the Department of Conservation and Recreation as part of the Virginia Natural Area Preserve System. The Great Dismal Swamp National Wildlife Refuge also protects some important

pocosin communities. Despite great success in land acquisition realized by natural resource agencies and land conservation organizations, long-term survival of pocosin communities, and the rare plants and animals living within them, will depend on management efforts focused on maintaining the community in its natural state. The two driving ecological forces within these wetlands are fire and the cycling of water. Today, unrestrained fire represents a hazard to public safety and property, but the benefits of carefully prescribed and controlled fire can be realized. Studies are underway to learn more about the flow of water through these wetlands and the in-

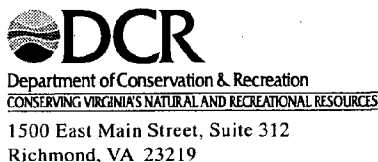
fluence of adjacent land use on water quality. A plan to restore and maintain clean water flow through the wetland, and the reintroduction of fire will greatly increase the chances for survival of this endangered ecosystem.

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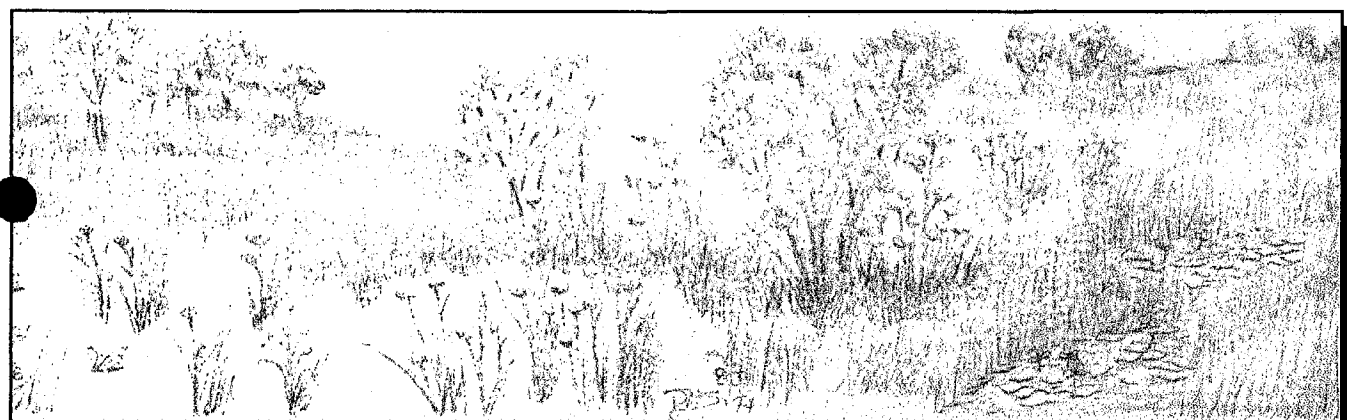
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Virginia's Rare Natural Environments

Sea-level Fens

Description

Virginia's sea-level fens are an extremely rare type of coastal wetland distinguished from a marsh and a bog by a distinct hydrologic regime and unique vegetation associations. In general, sea-level fens are open, freshwater wetlands located at the upland edges of wide, oceanside tidal marshes. Unlike bogs, whose primary water source is rainwater, a sea-level fen's primary water source is an underground spring that supplies nutrient-poor groundwater to the system. For a sea-level fen to form, a combination of environmental factors must occur. First, a natural spring, usually seeping from a nearby slope, must be present to allow the movement of groundwater into the area. Second, the fen must be sufficiently protected from flooding, such as by a wide, fronting tidal marsh, to prevent the influx of nutrient-rich tidal flow. If these two conditions are met, unique plant associations that include both northern bog species and southern freshwater tidal species can form, and diagnostic plant species such as ten-angled pipewort and beaked spike-rush can thrive. It is uncommon to find this combination of environmental factors, which accounts for the rarity of this community type.



Sea-level Fen Community

Distribution

Sea-level fens were first discovered in 1991. Superior examples of this community type have been found in only five locations on the East Coast, and cover a total of no more than 10 acres. Although there are likely many more examples of this community type, thus far they have only been documented in Sussex County, Del., and in Accomack County on Virginia's Eastern Shore.

Flora and Fauna

The low nutrient content of the water and the acidic conditions of

the soil strongly affect the plants and animals that exist in sea-level fens. Vegetation consists of an interesting combination of acid-tolerant bog plants and tidal freshwater wetland plants capable of surviving in low-nutrient areas. For some of these species, the Virginia sea-level fens represent the southernmost extent of their range, and the only habitat that supports these species in the state. Most interesting among the vegetation are the many carnivorous plants such as sundew and bladderwort which capture and digest small insects and invertebrates.

Since their discovery in 1991, few investigations into the resident animal populations of sea-level fens have been conducted. However, one species of interest found in these areas is a dragonfly, *Nanothemis bella*, which, at 3/4 inch long, is the smallest northeastern dragonfly. Also characteristic of these environments is the eastern mud turtle which, not surprisingly, thrives in the mucky, springy habitat.

Values

The natural heritage values associated with these small wetlands are focused primarily on the plant and

Virginia's Rare Natural Environments

Sea-level Fens

animal species that they harbor; often these communities are the only location for a species in the state. The number of rare species documented in fens is significant. These areas are also ecologically interesting in that they incorporate both freshwater marsh plants and acid-tolerant bog plants which are more common in northern bogs.

Threats

By far the biggest threat to this rare community type is groundwater pollution. The possible movement of fertilizers and wastes into the groundwater from nearby develop-

ments or agricultural fields can cause an influx of nutrients into the fen. This upsets the balance of water and nutrients in the area and leads to the disruption of soil characteristics and plant species that exist in fen conditions. Increased nutrient and sediment flow could result in suitable environmental conditions for the growth of invasive species such as common reed.

Protection:

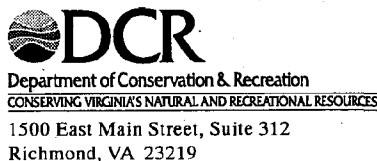
Protection of these rare wetland communities will take a concentrated effort on the part of landowners and environmental agencies to

prevent the flow of high nutrient water and sediments into these areas. Although fens may be protected to some extent by wetland regulations of the Federal Clean Water Act, negative influences from surrounding environments can be devastating to these areas and protection is essential to ensure their continued existence.

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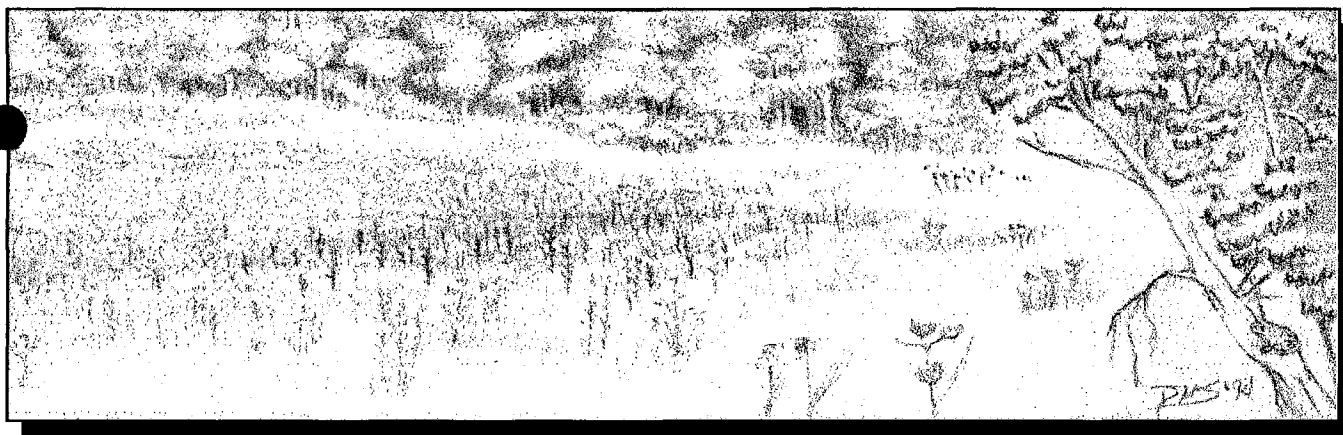
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Virginia's Rare Natural Environments

Seasonal Ponds

Description

The use of the word *pond* may be somewhat misleading in the case of seasonal pond communities. More accurately, they are shallow depressions in the ground that contain standing water for all or, usually, part of the year. Some larger ponds are actually forested. The amount and duration of standing water varies among ponds and strongly influences the plant and animal associations that are present. Most ponds are sinkhole depressions which were created by the dissolution of underlying substrate and the subsequent collection of water and sediments in the depression. In the coastal plain, this underlying material is calcareous and consists of ancient shell deposits. In the Shenandoah Valley, the underlying material is limestone. Finally, some ponds are simply lowlands within dune landscapes. Sinkhole ponds in Virginia are referred to as seasonal because the depressions do not hold water for extended periods of time. The hydrology of seasonal ponds varies, but they generally have standing water during early spring, the wettest time of the year, and gradually dry through the summer and fall. The length of time standing water remains in the ponds can change from year to year; ponds will have more water for longer periods during wet years than during drought years. Seasonal ponds range anywhere in size from 50 feet to several hundred feet or more in diameter.



Seasonal Pond Community

Distribution

Seasonal ponds are scattered throughout the coastal plain from the Maritime Provinces to the Gulf Coast of Texas. They are especially prevalent in the Carolinas where the ponds form a regular feature along the fall line. In Virginia, seasonal ponds are not as common. They are found in scattered sites in the southeastern part of the state, and on the Eastern Shore. Two sites of particular note are the Grafton Ponds complex in York County and Newport News, and the small ponds located

within Seashore State Park and Natural Area in Virginia Beach. Seasonal ponds are also found in the Shenandoah Valley in Augusta and Rockingham counties where the geologic features are different.

Flora and Fauna

Fluctuations of water levels vary considerably among ponds depending on their age and location. Water levels also vary from year to year within a single pond. The result is a diverse plant and animal richness within the entire pond complex that

can add up to be more valuable than any individual pond considered on its own. Several rare Virginia plant species such as harper's fimbriatylis and black-fruited spikerush are found along the edges of coastal plain seasonal ponds. The endemic Virginia sneezeweed is found at the margins of Shenandoah Valley seasonal ponds as are several other rare plant species.

Animal species also commonly inhabit seasonal ponds. Because the ponds contain standing water for only part of the year, they are un-

Virginia's Rare Natural Environments

Seasonal Ponds

able to support fish and therefore provide an ideal, predator-free breeding habitat for many amphibian species. Mabey's salamander is a rare amphibian that breeds at some seasonal ponds in Virginia. Another rare amphibian, the barking tree frog, is a northern species with its southern range limit in Virginia. It is only found in the southeastern part of the state and requires a fish-free, freshwater habitat to reproduce. Several rare and unusual dragonflies also inhabit these specialized environments.

Values

Seasonal ponds are especially important for the unique diversity of plants and animals that inhabit them. A network of several ponds is a complex, interwoven system of wetland communities. Often plant species in these ponds are at their southern limit, or are endemic to Virginia. In addition, the importance of these habitats as predator-free breeding grounds for amphibians cannot be overemphasized.

Threats

Considering the varied hydrologic nature of seasonal ponds and the di-

versity of life contained within an entire pond complex, protection of the surrounding habitat, with particular attention to maintaining water regimes, is required to preserve the character of these natural communities. Draining, ditching, and dredging can disrupt the natural water cycles upon which the community is based. In addition, nutrient levels need to be maintained in the ponds; runoff from fertilized agricultural fields can increase sediment and nutrient levels in ponds and alter the plant communities that can survive there. Finally, it is important to remember that few species will use seasonal ponds as their only habitat. Amphibians in particular may be present at ponds only to mate and lay eggs. Surrounding upland natural areas should be protected with the ponds themselves to provide living habitats for species. As well, the ponds will provide an avenue for dispersal of seeds or young to new ponds.

Protection

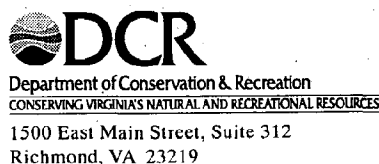
Long-term protection of this rare community type will depend on environmentally sound planning and development around these areas.

Although seasonal ponds may have some protection under wetland regulations of the Federal Clean Water Act, interpretations of these laws often change and should not be solely depended upon for protection. Additionally, regulations often don't provide for the protection of surrounding upland habitats and may allow damaging activities in some cases. Protecting the hydrologic conditions of the ponds and adjacent upland environments is critical to their long-term preservation.

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Natural Heritage Resources Fact Sheet

● Virginia's Rare Natural Environments

Turkey Oak Sandhills

Description

Sandhills are distinctive natural communities which occur on well drained, sandy soils primarily in the southeastern coastal plain from Virginia southward. Where they are found, they are characterized by abundant sand and scattered trees. Well-drained soils set up dry, nutrient-poor growing conditions on a sandhill. The dominant trees are species of pine and oak while understory plants generally consist of shrubby plants with an occasional patch of herbaceous vegetation and lichens. Longleaf pine and turkey oak are the dominant trees which characterize sandhills in Virginia. These sandhills resemble their counterparts in the Carolinas with some slight differences. Frequent, low-intensity fires were common in Virginia sandhills as a means of maintaining the vegetation, although in recent years fires have been suppressed or controlled for safety considerations. Human disturbance, in conjunction with the suppression of natural fires, has altered these communities to a great extent.



Turkey Oak Sandhill Community

Distribution

There is evidence that longleaf pine and turkey oak were more common in Virginia before human settlement. However, lumbering and agricultural development over the past 250 years have taken their toll on sandhill communities. In Virginia, the best remaining examples of turkey oak sandhills are found in Isle of Wight County. Sandhill communities are also found in Southampton County and Suffolk.

Flora and Fauna

● The turkey oak sandhills of Virginia support a number of rare plant and animal species, some of which are at the northern limit of their range. Locally, layers of clay beneath the

sand trap water and allow rare blue jack oak and longleaf pine to survive. In addition, these areas contain rare shrubby and herbaceous vegetation such as sandy-woods chaffhead, creeping blueberry, October-flower, and flowering pixie-moss.

Noteworthy animal species which inhabit Virginia sandhill communities include southeastern crowned snakes, rare tiger beetles, and numerous butterfly and moth species, including a moth that feeds specifically on pixie-moss. With some clearing of the undergrowth, this area would be excellent potential habitat for the federally endangered red-cockaded woodpecker.

Threats

Turkey oak sandhills are one of the most endangered ecosystems in Virginia. Without regular fires to remove the buildup of shrubby, understory vegetation, common tree species would be able to thrive and replace the longleaf pine and turkey oak. The most effective means of maintaining the community is by regular prescribed burns to curb the growth of encroaching vegetation. Many of the plants in this community type, such as the longleaf pine, require fire for successful reproduction. In addition, disturbance of surrounding lands can have an impact on sandhills. In particular, construction of houses near the community could limit the frequency and extent

Virginia's Rare Natural Environments

Turkey Oak Sandhills

of burning allowed in the area. Sand mining and ditching can affect the natural flow of water to the site disrupting the natural cycling of water and nutrients, and influencing the species of plants that are present. Finally, clearcutting a sandhill community permits the growth of common loblolly pines and is an ongoing, serious threat.

Protection

The only currently protected tract of turkey oak sandhill in Virginia is found in the Blackwater Ecologic Preserve in Isle of Wight County.

Protection of these communities will depend on a regular schedule of prescribed burning to maintain the necessary sandhill conditions. The recent introduction of prescribed burning to the Blackwater Ecologic Preserve has resulted in the re-emergence of some species not found here since natural fires were suppressed. Historic records indicate the presence of numerous rare species in these sandhills; some may reappear with continued management, prescribed burns, and protection from disturbance.

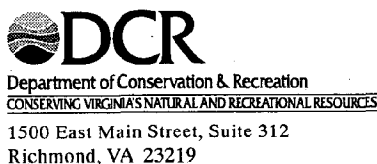
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WARNING! INVASIVE ALIEN PLANTS

WHY ARE ALIEN PLANTS A SERIOUS THREAT?

Plants that are not a part of the indigenous (native) vegetation, but that have been introduced into a region are called aliens. For the most part, introduced, or alien, plant species form an important part of our environment, contributing immensely to agriculture, horticulture, landscaping, and soil stabilization. But among the thousands of plant species introduced to our area, some have displayed unexpected aggressive growth tendencies. The purpose of this fact sheet is to identify some of the more problematic species which, in many circumstances, degrade native plant communities.

While most alien plant species do not persist in the wild, introductions since European settlement have substantially changed the composition of native plant communities throughout North America. Of the roughly 2500 vascular plant species that grow in the wild in Virginia, some 350 are not native to the state. While many of these are restricted to roadsides and other heavily-disturbed sites, others readily invade natural and semi-natural landscapes.

Invasive alien plants typically exhibit the following characteristics:

- rapid growth and maturity,
- prolific seed production,
- highly successful seed dispersal, germination, and colonization,
- rampant spread,
- ability to out-compete native species,
- high cost to remove or control.

Invasive aliens thrive on disturbed sites. Native plant communities fragmented by human disturbances are most vulnerable to invasion, but even intact ecosystems can be invaded by the most aggressive alien species. Invasive alien plants leave behind the natural controls (e.g. insects) that keep them in check in their native habitats. Biodiversity is further threatened when alien plants harbor invasive pathogens, fungi, or other organisms that decimate native species, such as American Chestnut.

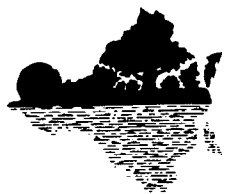
AWARENESS IS CRITICAL

Awareness of the problems caused by invasive alien plants is the first step in preventing their continued use. Public awareness will help increase responsible landscaping and conservation practices. Awareness by resource managers will help prevent the introduction of these species on public lands and preserve our natural heritage.

HOW YOU CAN HELP

Learn what species are native in your area. Use native species, grown from local stock if available, for conservation and landscaping purposes whenever possible. When using alien plants, avoid highly invasive species. Support public policies that restrict the introduction of invasive alien plants and get involved in organizations and agencies that work to protect biological diversity. Ask your nursery to sell native plants propagated from local stock. Plan and implement sound practices for the control of invasive alien plants in natural areas. A list of alien plants that have invasive tendencies in Virginia is provided on the overleaf.

FOR MORE INFORMATION, CONTACT:



Virginia Native Plant Society
P.O. Box 844
Annandale, Virginia 22003

or



Department of Conservation and Recreation
Division of Natural Heritage
1500 East Main Street, Suite 312
Richmond, Virginia 23219

INVASIVE ALIEN PLANTS OF VIRGINIA

Common Name

Scientific Name

Alligator-weed
Amur cork-tree^o
Amur honeysuckle^o
Aneilima[•]
Asiatic sand sedge[•]
Autumn olive
Balloon-vine^o
Beafsteak plant[•]
Bell's honeysuckle^o
Bermuda-grass
Birdsfoot trefoil
Black pine^o
Blunt-leaved privet
Brazilian water-weed
Bristled knotweed
Brown knapweed
Bugleweed
Bull-thistle[•]
Canada bluegrass
Canada-thistle[•]
Chinese lespedeza[•]
Chinese privet
Chinese tallow tree^o
Chinese wisteria
Chinese yam[•]
Common buckthorn
Common chickweed
Common cocklebur
Common day-flower
Common morning-glory
Common reed[•]
Common teasel
Crown-vetch[•]
Curled dock
Curled thistle[•]
Cut-leaf teasel
Empress-tree
English Ivy[•]
Eulalia[•]
European water-milfoil
Fennel
Field-bindweed
Fiveleaf akebia[•]
Garlic mustard[•]
Giant foxtail
Giant reed[•]
Gill-over-the-ground[•]
Glossy buckthorn^o
Hydrilla[•]
Ivy-leaved morning-glory
Japanese barberry[•]
Japanese honeysuckle[•]
Japanese hops
Japanese knotweed[•]
Japanese spiraea
Japanese wisteria^o
Johnson-grass[•]
Jointed charlock
Jointed-grass

Alternanthera philoxeroides
Phellodendron amurense
Lonicera maackii
Murdannia keisak
Carex kobomugi
Elaeagnus umbellata
Cardiospermum halicababum
Perilla frutescens
Lonicera x bella
Cynodon dactylon
Lotus corniculatus
Pinus thunbergii
Ligustrum obtusifolium
Egeria densa
Polygonum cespitosum
Centaurea jacea
Ajuga reptans
Cirsium vulgare
Poa compressa
Cirsium arvense
Lespedeza cuneata
Ligustrum sinense
Sapium sebiferum
Wisteria sinensis
Dioscorea batatas
Rhamnus cathartica
Stellaria media
Xanthium strumarium
Commelina communis
Ipomoea purpurea
Phragmites australis
Dipsacus sylvestris
Coronilla varia
Rumex crispus
Carduus acanthoides
Dipsacus laciniatus
Paulownia tomentosa
Hedera helix
Microstegium vimineum
Myriophyllum spicatum
Foeniculum vulgare
Convolvulus arvensis
Akebia quinata
Alliaria petiolata
Setaria faberi
Arundo donax
Glechoma hederacea
Rhamnus frangula
Hydrilla verticillata
Ipomoea hederacea
Berberis thunbergii
Lonicera japonica
Humulus japonicus
Polygonum cuspidatum
Spiraea japonica
Wisteria floribunda
Sorghum halepense
Raphanus raphanistrum
Arthraxon hispidus

Common Name

Scientific Name

Kudzu-vine[•]
Leafy spurge^o
Lesser celandine
Linden viburnum^o
Mile-a-minute[•]
Mimosa
Moneywort
Morrow's honeysuckle[•]
Mugwort[•]
Multiflora rose[•]
Musk thistle
Nipplewort
Norway maple
Oatgrass
Orchard-grass
Oriental bittersweet[•]
Parrot's feather
Periwinkle
Poison hemlock
Porcelain-berry[•]
Purple loosestrife^{•□}
Purple loosestrife^{•□}
Quack-grass
Red morning-glory
Red sorrel
Redtop
Rhode Island bent-grass
Rough bluegrass
Russian olive^o
Sawtooth oak^o
Short-fringed knapweed
Siberian elm^o
Sickle-pod
Spotted knapweed[•]
Sweet breath of spring^o
Tall fescue[•]
Tartarian honeysuckle^o
Thorny elaeagnus
Timothy
Tree of heaven[•]
Velvet-grass
Water chestnut^o
Water-flag
Weeping lovegrass
White mulberry
White poplar
White sweet clover
Wild onion
Wild parsnip
Wineberry
Winged burning bush^o
Wintercreeper^o
Yellow sweet clover

Pueraria lobata
Euphorbia esula
Ranunculus ficaria
Viburnum dilitatum
Polygonum perfoliatum
Albizia julibrissin
Lysimachia nummularia
Lonicera morrowi
Artemisia vulgaris
Rosa multiflora
Carduus nutans
Lapsana communis
Acer platanoides
Arrhenatherum elatius
Dactylis glomerata
Celastrus orbiculatus
Myriophyllum aquaticum
Vinca minor
Conium maculatum
Ampelopsis brevipedunculata
Lythrum salicaria
Lythrum virgatum
Agropyron repens
Ipomoea coccinea
Rumex acetosella
Agrostis gigantea
Agrostis tenuis
Poa trivialis
Elaeagnus angustifolia
Quercus acutissima
Centaurea dubia
Ulmus pumila
Cassia obtusifolia
Centaurea maculosa
Lonicera fragrantissima
Festuca elatior
Lonicera tatarica
Elaeagnus pungens
Phleum pratense
Ailanthus altissima
Holcus lanatus
Trapa natans
Iris pseudacorus
Eragrostis curvula
Morus alba
Populus alba
Melilotus alba
Allium vineale
Pastinaca sativa
Rubus phoenicolasius
Euonymus alatus
Euonymus fortunei
Melilotus officinalis

- Especially troublesome
- o Persistence in Virginia uncertain
- Including all cultivars

Scientific names follow Atlas of the Virginia Flora III by Harvill, et al., 1992.

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Invasive Alien Plant Species of Virginia

Asiatic Sand Sedge (*Carex kobomugi*) Ohwi

Description

Asiatic sand sedge is a perennial sedge which grows to about a foot in height. The stem is triangular, and the base of the stem is covered with brown scales. Young leaves are yellow-green in color and stiff with a rough texture along their edges. Older, basal leaves are somewhat wider, darker green in color and leathery to the touch. The leaves are often taller than the flowering heads of the plant. Flowering heads are either male or female, and are crowded into dense clusters at the tops of the stems. Female flower clusters are longer and more slender than the more cylindrical male flower clusters. The fruits are triangular nutlets known as achenes and are enclosed in a papery sac surrounded below by scales and bracts. Asiatic sand sedge spreads rapidly by underground stems.



Asiatic Sand Sedge (*Carex kobomugi*)

Distribution

Asiatic sand sedge is an east Asian native which was introduced into coastal sands from New Jersey to Virginia in the 1930's for erosion control and as a sand stabilizer. The plant is typically found on coastal dunes and berms, although it is also occasionally found in dry, sandy inland areas. In Virginia, it was introduced into the Sandbridge area and has recently been documented in Accomack County and the cities of Virginia Beach and Chesapeake. Its tolerance for salt spray and high winds allows it to survive in dune habitats occupied by unique native vegetation.

Threats

The stems of Asiatic sand sedge form low, dense mats in dunes which crowd out native dune species such

as American beach grass, coastal spurge, sea oats, and sea-coast marsh elder. Once established, Asiatic sand sedge dramatically changes the profile of a dune. Tall, native plants such as sea oats buffer the dune from the strong forces of wind and salt spray. When native plants are crowded out by the low-growing Asiatic sand sedge, the dunes are vulnerable to shifting sands and blowouts.

Control

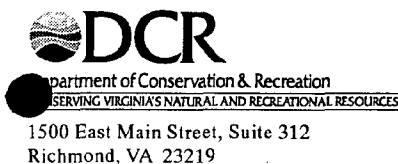
Early detection of this invasive plant is important for successful control, as small populations are easier to manage than larger ones. Removal by pulling or digging out the plants is recommended only for very small infestations. Large patches of this invasive are best controlled by the application of a biodegradable glyphosphate herbicide to individual

plants. Herbicide application is best accomplished at the end of the growing season when plants are actively transporting nutrients from stems and leaves to root systems. Glyphosphate herbicides affect all green vegetation and should be used sparingly so as not to contact desirable species which may be growing with the Asiatic sand sedge. As with hand pulling control methods, follow-up treatments may be needed in subsequent years to remove plants that have sprouted from remaining seeds.

Reference

Fernald, M. L. 1950. Gray's Manual of Botany, eighth edition. American Book Company, New York. 1632 pp.

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Invasive Alien Plant Species of Virginia

Autumn Olive (*Elaeagnus umbellata* Thunberg)

Russian Olive (*Elaeagnus angustifolia* L.)

Description

Autumn olive is a deciduous shrub or small tree in the Oleaster family. Leaves are alternate, oval to lanceolate, and untoothed. The underside of the dark green leaf is covered with silver-white scales. The plant may grow to a height of 20 feet. The small, light yellow flowers are borne along twigs after the leaves have appeared early in the growing season. The small, round, juicy fruits are reddish to pink, dotted with scales, and produced in great quantity. Autumn olive is easily confused with a closely related species, Russian olive (*Elaeagnus angustifolia*), which is also an invasive species. Russian olive has elliptic to lanceolate leaves, its branches are usually thorny, and its fruit is yellow, dry and mealy. Identification should be confirmed by a specialist.

Habitat

Autumn olive has nitrogen-fixing root nodules which allow it to thrive in poor soils. Typical habitats are disturbed areas, roadsides, pastures and fields in a wide range of soils. Autumn olive is drought tolerant and may invade grasslands and sparse woodlands. It does not do well on wet sites or in densely forested areas.

Russian olive can be found in dry to moist soils, but does particularly well in sandy floodplains.

Distribution

Autumn olive was introduced to the United States from east Asia in the 1830s. It is found from Maine south to Virginia, and west to Wisconsin. Autumn olive was planted in the eastern and central United States for revegetation of disturbed areas. Birds forage on its fruit and contrib-

ute to seed dispersal. It is widely distributed in Virginia, having been recorded in 46 counties.

Russian olive, native to Eurasia, was planted as an ornamental and escaped cultivation in the central and western United States. At this time, Russian olive is rare in Virginia, where it has been reported only from Accomack, Fairfax, Northumberland and Warren counties.

Threats

Autumn olive is a very troublesome invasive species in Virginia. In addition to its prolific fruiting, seed dispersal by birds, rapid growth and ability to thrive in poor soil, Autumn olive resprouts vigorously after cutting or burning. It creates heavy shade which suppresses plants that require direct sunlight.

Although rare in Virginia, Russian olive poses similar threats. In the



Autumn Olive (*Elaeagnus umbellata*)

western United States it has become a major problem in riparian wood-

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Invasive Alien Plant Species of Virginia

Autumn Olive

Russian Olive

lands, threatening even large, hardy native plants such as cottonwood.

Control

Seedlings and sprouts can be hand-pulled when the soil is moist to insure removal of the root system. On larger plants, cutting alone results in thicker, denser growth. Burning during the dormant season also results in vigorous resprouting.

A glyphosate herbicide can be used to control larger plants. Foliar application has proven effective in controlling these species. Since glyphosate is nonselective and will affect all green vegetation, care should be taken to avoid impacting native plant species. At sites where this is a concern, application of the herbicide to the freshly cut stumps of the invasive shrub should achieve the desired results. This method minimizes damage to other plants. Glyphosate herbicides are recom-

mended because they are biodegradable, breaking down into harmless components on contact with the soil. To be safe and effective, herbicide use requires careful knowledge of the chemicals, appropriate concentrations, and the effective method and timing of their application. Consult an agricultural extension agent or a natural resource specialist for more details on herbicide control measures.

Suggested Alternative Plantings

There are many native species which are attractive as ornamentals, stabilize soils, and provide food and cover for wildlife. Winterberry (*Ilex verticillata*), black haw (*Viburnum prunifolium*), gray dogwood (*Cornus racemosa*) and shining sumac (*Rhus copallina*) all provide a winter source of food for birds. Serviceberry (*Amelanchier* spp.) blooms early in the spring and its

fruits are quickly eaten by birds. Other alternatives are evergreens such as American holly (*Ilex opaca*), bayberry (*Myrica pennsylvanica*) and wax myrtle (*Myrica cerifera*). All are available at local nurseries.

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For more information, contact the Department of Conservation and Recreation or the Virginia Native Plant Society.



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Invasive Alien Plant Species of Virginia

Bush Honeysuckles: Belle's honeysuckle (*Lonicera x bella* Zabel), Fragrant honeysuckle (*L. fragrantissima* Lindley & Pax), Amur honeysuckle (*L. mackii* (Rupr.) Maxim), Morrow's honeysuckle (*L. morrowi* A. Gray), Tatarian honeysuckle (*L. tatarica* L.), European fly honeysuckle (*L. xylosteum* L.)

Description

Bush honeysuckles are upright, generally deciduous shrubs that range from 6 to 16 feet in height. The opposite, simple leaves are usually oval to oblong in shape and range in length from 1 to 2.5 inches. Flowering occurs from May to June (February to April for fragrant honeysuckle) with the fragrant, tubular flowers borne in pairs. Flower color ranges from creamy-white in most species to pink or crimson in varieties of Tatarian honeysuckle. Whitish flowers become yellow with age. The fruit is a many-seeded, red to orange berry. Exotic bush honeysuckles can be confused with our Virginia native fly honeysuckle (*Lonicera canadensis*), but this seldom-seen species is restricted to high elevation mountainous terrain. Consult an appropriate guidebook or a natural resource expert for proper identification.

Habitat

In Virginia bush honeysuckles occur most often along roadsides and in forest edges, pastures and abandoned fields. Grazed and disturbed woodlots may also be invaded by some bush honeysuckle species. Although bush honeysuckles are most common in upland habitats, Morrow's honeysuckle is known to invade fens, bogs and lakeshores in portions of the northeastern United States.

Distribution

The invasive bush honeysuckles in Virginia are natives of Europe, eastern Asia or Japan. Most species have been cultivated as ornamentals in the eastern United States since the mid-1800s. Also, some varieties were developed and planted widely for

wildlife food source. At present, bush honeysuckles are distributed locally in Virginia, particularly in northern and central regions, although their ranges appear to be expanding.

Threats

Bush honeysuckles can rapidly invade and overtake a site, forming a dense shrub layer that interferes with the life cycles of many native woody and herbaceous plants. Exotic bush honeysuckles can alter habitats they invade by decreasing light availability and depleting soil moisture and nutrients. Some species may also release chemicals into the soil that inhibit the growth of other plant species. The fruit of bush honeysuckles is fed upon by many kinds of birds. The birds then spread the seed



Morrow's honeysuckle (*L. morrowi*)

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Invasive Alien Plant Species of Virginia

Bush Honeysuckles

throughout the landscape.

Control

Light infestations may be cleared by hand with a shovel or grubbing hoe provided the entire root is removed. Severe infestations may be controlled by repeated treatments of cutting, burning or applying herbicide.

Brush cutting plants should be done during the growing season. Generally two cuts per year are recommended, one in early spring followed by one in the late summer or early autumn. Cuts made in the winter while the plant is dormant will only encourage vigorous resprouting.

The application of an herbicide is also an effective control method. Glyphosate herbicides are recommended because they are biodegrad-

able. They will begin to break down into harmless components on contact with the soil. A glyphosate herbicide may be applied to the leaves or freshly cut stumps late in the growing season. Timing is important to insure effectiveness. Application near the end of the growing season when the plant is transporting nutrients to its roots will result in the highest rate of kill.

In some areas, prescribed burning may be used to control bush honeysuckles. Burns conducted during the growing season will top-kill shrubs and inhibit new shoot production. These burns will favor warm-season grasses and perennial forbs increasing species diversity and productivity.

Treatment of any severely infested areas usually requires management for a period of three to five years to

inhibit growth of new shoots and eradicate target plants. Consult a natural resource specialist or an agricultural extension agent for more information on these control methods.

*Written by Dr. Charles E. Williams,
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University*

References

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Harvill, A. M., Jr., et al. 1992. Atlas of the Virginia Flora, 2nd ed. Virginia Botanical Associates, Farmville, Va.

For more information, contact the Department of Conservation and Recreation or the Virginia Native Plant Society.



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Invasive Plant Species of Virginia

Common Reed (*Phragmites australis* (Cav.) Trin. ex Steud.)

Description

Common reed is a tall perennial wetland grass ranging in height from three to 13 feet. Strong, leathery horizontal shoots growing on or beneath the ground surface (rhizomes) give rise to roots and tough vertical stalks. These stalks support broad sheath-type leaves that are one-half to two inches wide near the base, tapering to a point at the ends. The foliage is gray-green during the growing season, with purple-brown plumes appearing by late June. The plant turns tan in the fall and most leaves drop off, leaving only the plume-topped shoot. Big cordgrass (*Spartina cynosuroides*), a non-invasive species, is sometimes confused with common reed. It can be distinguished from common reed by its sparser flowering structure and longer, narrower leaves.

Habitat

Common reed thrives in sunny wetland habitats. It grows along drier borders and elevated areas of brackish and freshwater marshes and along riverbanks and lakeshores. The species is particularly prevalent in disturbed or polluted soils found along roadsides, ditches and dredged areas.

Distribution

Found throughout the temperate regions of North America, common reed is widespread in eastern Virginia and also can be found in some western areas of the state. It is strongly suspected that a non-native, aggressive strain of the species was carried to North America in the early 20th century.

Life History

Common reed spreads to a new area by sprouting from a rhizome fragment or from seed. New upright stems grow from the rhizome each spring. Rhizomes spread horizontally in all directions during the growing season. Flowering begins in late June, and seeds are formed by August. In early autumn, food reserves move from leaves and stems to the rhizome system. The leaves die and fall off, with only the dead brown

vertical shoots remaining. The accumulation of dead leaves and stems, as well as the pervasive rhizome system, prohibits the growth of desirable plant species.

Threats

Common reed has become a destructive weed in Virginia, quickly displacing desirable plant species such as wild rice, cattails and native wetland orchids. Invasive stands of common reed eliminate diverse wetland plant communities, and provide little food or shelter value for wildlife.

Prevention

Minimizing land disturbances and water pollution helps deter this invasive species. Land management practices that guard against erosion, sedimentation, fluctuating water levels and nutrient loading in wetlands are the best long-term protection.

Control

Once established, common reed is very difficult to completely eradicate. However, careful planning and long-term management can yield varying levels of control. Herbicide use in combination with



Common Reed (*Phragmites australis*)

Illustration courtesy Wetland Program,
Virginia Institute of Marine Science
Artist: Rita Llanso

burning has generally proven to be the most effective means of control, and results in minimal disturbance to wetlands. Only a special, bio-degradable herbicide which is non-toxic to animals and licensed for use in wetlands can be used. Because a healthy wetland ecosystem is generally resistant to invasive species, long-term control of common reed depends upon restoration of the health of the ecosystem.

For more information about common reed, contact the Department of Conservation and Recreation at 804/786-7951, the U.S. Fish & Wildlife Service at 804/721-2412 or the Virginia Native Plant Society.



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Invasive Alien Plant Species of Virginia

Garlic Mustard (*Alliaria petiolata* (Bieb.) Cavara & Grande)

Description

Garlic mustard is a biennial herb in the mustard family. Plants can range in height from 5 to 46 inches. The first year plants form rosettes of kidney-shaped leaves. In its second year, the plant grows a stem with leaves that are triangular and sharply toothed. The flowers are born in a cluster at the end of the stem, and each small flower has four white petals. Seeds are black, oblong and found in rows within a long narrow capsule called a silique. Crushed leaves and stems of this plant give off a distinctive garlic odor.

Habitat

Garlic mustard grows in rich, moist upland forests and wooded streambanks. It is shade tolerant and readily invades disturbed areas such as roadsides and trail edges. Garlic mustard cannot tolerate acidic soils, including undrained peat or muck.

Distribution

Native to Europe and Asia, garlic mustard is now found in Canada, south to Virginia, and as far west as Kansas and Nebraska. It is believed to have been brought to North America by European settlers for use in cooking and medicine. In Virginia, garlic mustard is found throughout the state, with notable exceptions of southeastern and northeastern counties.

Threats

This species can invade a forest through a disturbance such as treefall or trail construction. Along streambanks, the plant does exceptionally well because of the distur-

bance created by periodic flooding. Prolific seed production and lack of natural predators which might feed on garlic mustard allow it to quickly dominate the ground cover. Native herbs in competition with garlic mustard may suffer population declines.

Control

Light infestations of garlic mustard can be controlled by hand-pulling. Plants should be pulled before seeds have ripened. Care must be taken to insure the entire root is removed and disturbance of the soil is minimal.

Severe infestations can be controlled with herbicides. Garlic mustard is biennial. Its first year growth overwinters as a basal rosette of kidney-shaped leaves, therefore it is still green when many other herbs have died or gone into dormancy. Foliar application of a glyphosate herbicide can be made in late fall to minimize damage to other plants. Follow-up treatments may be necessary over two or three years to get target



Garlic Mustard (*Alliaria petiolata*)

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Invasive Alien Plant Species of Virginia

Garlic Mustard

plants that were missed as well as new sprouts. Glyphosate herbicides are recommended because they are biodegradable, breaking down into harmless components on contact with soil. However, glyphosate is a nonselective, systemic herbicide and will affect all green vegetation. To be safe and effective, herbicide use requires careful knowledge of the chemicals, appropriate concentra-

tions, and the effective method and timing of their application. For more information on herbicide use, contact a natural resource specialist or agricultural extension agent.

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For more information, contact the Department of Conservation and Recreation or the Virginia Native Plant Society.



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Invasive Alien Plant Species of Virginia

Japanese Honeysuckle (*Lonicera japonica* Thunberg)

Description

Japanese Honeysuckle is a trailing or twining woody vine that can grow to more than 30 feet in length. Young stems are often hairy; older stems are hollow with brownish bark that may peel off in shreds. The simple, opposite leaves are oval to oblong in shape and range from 1.5 to 3 inches in length. In much of Virginia, leaves of Japanese honeysuckle are semievergreen and may persist on vines year-round. The extremely fragrant, two-lipped flowers are borne in pairs in the axils of young branches and are produced throughout the summer. Flowers range from 1 to 2 inches in length and are white with a slight purple or pink tinge when young, changing to white or yellow with age. The fruit is a many-seeded, black, pulpy berry that matures in early autumn. Japanese honeysuckle is distinct from our two native honeysuckles, the trumpet honeysuckle (*Lonicera sempervirens*), and wild honeysuckle (*Lonicera dioica*). These natives both bear red to orange-red berries, and their uppermost pair of leaves is joined together.

Habitat

Japanese honeysuckle occurs primarily in disturbed habitats such as roadsides, trails, fencerows, abandoned fields and forest edges. It often invades native plant communities after natural or human induced disturbance such as logging, roadbuilding, floods, glaze and windstorms, or pest and disease outbreaks.

Distribution

Japanese honeysuckle is native to eastern Asia. Introduced to cultivation in 1862 on Long Island, Japanese honeysuckle is now widely naturalized in the eastern and central United States. Japanese honeysuckle was, and in some areas still is, planted as an ornamental ground

cover, for erosion control, and for wildlife food and habitat. In Virginia, Japanese honeysuckle is naturalized statewide, being most abundant in piedmont and coastal plain forests.

Threats

Where light levels are optimal, such as in forest edges, canopy gaps or under sparse, open forest, newly established Japanese honeysuckle vines grow and spread rapidly. Suppressed vines growing in dense shade, however, are capable of rapid growth and spread when light levels in a habitat are increased by disturbance. In forests, Japanese honeysuckle vines spread both vertically and horizontally by climbing up tree trunks and/or by trailing or clambering over the forest floor and associ-



Japanese Honeysuckle (*Lonicera japonica*)

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Invasive Alien Plant Species of Virginia

Japanese Honeysuckle

ated vegetation. Trailing vines produce stolons which root when they contact soil, aiding the vegetative spread and persistence of the species.

Dense, strangling growths of Japanese honeysuckle can impact desirable vegetation by decreasing light availability within the habitat, depleting soil moisture and nutrients, or by toppling upright stems through the sheer weight of accumulated vines. Negative effects of Japanese honeysuckle invasion include development of malformed trunks in trees, suppression of plant growth, inhibition of regeneration in woody and herbaceous plants, and alteration of habitats used by native wildlife.

Control

Small populations can be controlled by careful hand-pulling, grubbing with a hoe or a shovel, and removal of trailing vines. In old fields and roadsides, twice yearly mowing can slow vegetative spread, however, due to vigorous resprouting, stem density may increase.

In pine plantations or in fire-dependent natural communities, Japanese honeysuckle can be controlled by prescribed burning. Burning can greatly decrease the abundance of

Japanese honeysuckle within a habitat and limit its spread for one or two growing seasons.

Where prescribed burning or mowing is difficult or undesirable, Japanese honeysuckle may be treated with a glyphosate herbicide. Glyphosate is recommended because it is biodegradable and will begin to break down into harmless components on contact with the soil. However, it is nonselective and will affect all green vegetation. Therefore it is best applied to the semievergreen leaves with a spray or wick applicator in late autumn when other vegetation is dormant but Japanese honeysuckle is still physiologically active. Reapplication may be necessary to treat plants missed during the initial treatment. To be safe and effective, herbicide use requires careful knowledge of the chemicals, appropriate concentrations, and the effective method and timing of their application. Consult a natural resource specialist for more information on herbicide use and prescribed burning techniques.

Suggested Alternatives

Some native alternatives to Japanese honeysuckle for use in home landscaping include trumpet creeper

(*Campsis radicans*), Virginia creeper (*Parthenocissus quinquefolia*), and trumpet honeysuckle (*Lonicera sempervirens*). Wild ginger (*Asarum canadensis*) makes an excellent ground cover in shady areas. All these species are easy to cultivate, have wildlife and aesthetic value, and can generally be obtained from commercial sources or propagated by wild-collected seeds or cuttings.

*Written by Dr. Charles E. Williams,
Department of Biology, Clarion
University*

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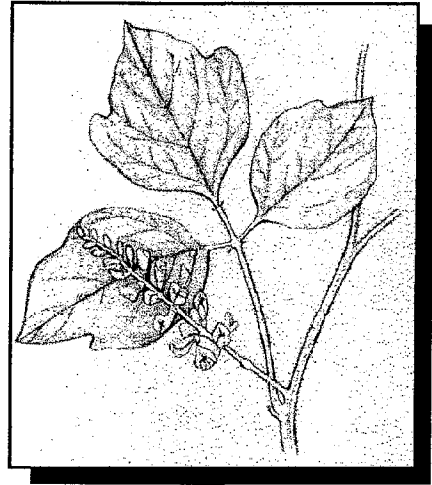
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Invasive Alien Plant Species of Virginia

Kudzu (*Pueraria lobata* (Willd.) Ohwi)

Description

Kudzu is a perennial, trailing or climbing vine of the legume family. Dark green leaves, starchy fibrous roots, and elongated purple flowers with a fragrance reminiscent of grapes readily identify this aggressive vine. A dense stand of identically colored plants growing on and around everything in its path is also a familiar field mark. Rarely flowering, kudzu stems and roots spread out in all directions from root crowns, with new plants beginning every one to two feet at stem nodes. This dense packing of kudzu can result in tens of thousands of plants occupying a single acre of land. Kudzu leaves are hairy beneath, often tri-lobed, and in groups of three on the vine. The 1/2 to 3/4 inch purple flowers are pea-like in shape and are produced on plants exposed to direct sunlight. Kudzu fruits, present in October and November, are hairy, bean-like pods which produce only a few viable seeds in each pod cluster. It is thought that some seeds can remain dormant for several years before they germinate. During the peak growing season in early summer, this prolific vine can grow at a rate of a foot a day, easily covering and choking trees and understory vegetation.



Kudzu (*Pueraria lobata*)

found in Florida where it has begun to invade the Everglades. Throughout Virginia, kudzu stands are a common sight along roadways and bordering agricultural fields.

Threats

Where it grows, kudzu has the ability to out-compete and eliminate native plant species and upset the natural diversity of plant and animal communities. Its extremely rapid growth rate and habit of growing over objects threatens natural areas by killing native vegetation through crowding and shading, and can seriously stifle agricultural and timber production. In addition, al-

Habitat


A hardy opportunist, kudzu grows in a variety of habitats and environmental conditions, but does best on deep, well-drained, loamy soils. Almost any disturbed area is suitable habitat for this vine. Roadsides, old fields, vacant lots and abandoned yards are all prime spots for new kudzu growth.

Distribution

A native of Japan, kudzu was brought to the southeastern United States at the turn of the century for

use as a soil stabilizer, animal fodder, and ornamental vine. Due to its prolific nature and lack of natural insect or disease controls, kudzu quickly made a pest of itself and was considered a nuisance by the early 1950s. In 1970 it was listed as a common weed by the Soil Conservation Service. Today, kudzu is spread along the Atlantic coast; north to Illinois and Massachusetts, west to Texas and Oklahoma, and south to Alabama, Georgia and Mississippi where the heaviest infestations occur. It has also recently been

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Invasive Alien Plant Species of Virginia

Kudzu

though edible by many grazing animals, its viney nature makes it difficult to cut and bale, making it undesirable as a hay crop. Grazing can eliminate kudzu fields in just a few years making them unsuitable for use as pastures except over a short time period. Because of its hardy nature and lack of natural enemies, kudzu is able to colonize diverse habitats and achieve a widespread distribution.

Control

Control of well established kudzu stands can take up to 10 years. Persistent eradication of all roots is the key to the control of this pest, keeping in mind that a single kudzu patch may extend past landowner boundaries. The most effective method of control will depend on several factors; size of the infested area, proximity to sensitive species or other desirable vegetation, and accessibility of the patch. Small patches of kudzu that are not well established (usually ones less than ten years old)

can be eliminated by persistent weeding, mowing, or grazing during the growing season over a period of three to four years. Unfortunately, with root systems that can be up to 12 feet deep, eradication by direct root removal is not practical.

Long-term treatment of heavily infested sites usually requires the application of herbicides over a period of up to five years to inhibit the growth of new shoots. Biodegradable glyphosphate herbicides are recommended for control of kudzu in natural areas. These herbicides break down rapidly into harmless components when exposed to soil. Because glyphosphate is a systemic, non-selective herbicide that affects all green vegetation, treatments should be carefully timed and applied by trained applicators. The best time for application of these herbicides is at the end of the growing season when the plants are actively transporting nutrients from leaves and stems to root systems. When applied at the proper time, herbicides are trans-

ported to the roots where they are able to kill the entire plant.

In some areas, prescribed burning may be used as a follow-up treatment after herbicide application. Although it should be carefully and professionally handled, this two step process is effective in clearing out leaf litter and speeding recolonization of an area by desirable native plant species.

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Invasive Alien Plant Species of Virginia

● Mile-a-minute (*Polygonum perfoliatum* L.)

Description

Also called tearthumb because of the spines on its leaves and stems, this annual vine of the smartweed family can climb up to 15 feet in height. Although similar to two native *Polygonum* species (arrow-vine and halberd-leaved tearthumb), mile-a-minute differs from these primarily in its leaves and fruits. The leaves are light green, one to three inches wide, and perfectly triangular. The fruits are berry-like, fleshy, blue, and approximately pea-sized. The most striking feature of this plant is the saucer-shaped sheath at the base of each leaf. This feature is not found on any other *Polygonum* species. Rapidly growing at about a half foot per day, mile-a-minute can reach lengths of 20 feet. This prolific vine easily grows over other vegetation, stealing nutrients, choking stems, and blocking sunlight.

Habitat

Mile-a-minute thrives in areas with plenty of direct sunlight and damp soil. It is especially prevalent along roadsides, ditches, stream banks, wet meadows, and clearcuts. It generally grows in areas with an abundance of leaf litter on the soil surface. This appears to help keep the soil moist and may aid in the germination of seeds.

Distribution

A native of Japan, mile-a-minute was accidentally brought to Pennsylvania in the 1930's with a shipment of rhododendrons. Its seeds were allowed to mature and were soon spread by birds and rodents that ate the fruits. In eight years, from 1981 to 1989, mile-a-minute extended its range in Pennsylvania from five to eleven counties. In recent years, it has crept down the coast into Maryland and Washington D.C., becoming established in more than half of Maryland's counties. Although not widely distributed in Virginia, mile-a-minute has the ability to rapidly colonize roadsides and waste areas and be-

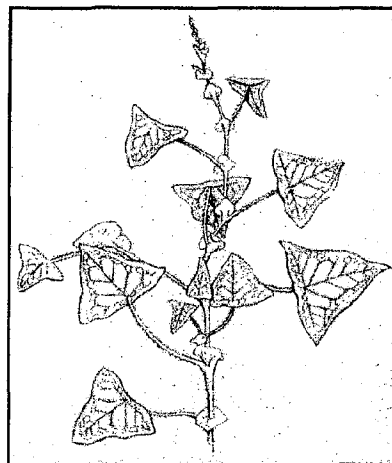
come a pest. So far it has been reported at a few sites in Northern Virginia.

Threats

Its rapid growth and viney nature allow mile-a-minute to overtake the native vegetation of an area, smothering seedlings and out-competing adult plants for space, nutrients and sunlight. This competition is a particular concern in wet meadows which may support rare wetland plants. Although it does not appear to be a threat to farmers, it can easily become a pest to gardeners and landscapers, destroying ornamental plants and landscaped yards.

Control

Because mile-a-minute is an annual (propagating only from seeds) with a shallow root system, this invasive is best removed from lightly infested areas by digging the plants up (with strong gloves to protect hands from the spines) and disposing of them before they go to seed. Seed set begins in early August and terminates at first frost. Removal of the plants is also best accomplished before



Mile-a-minute (*Polygonum perfoliatum*)

the plant becomes excessively viney. Removal of brush, leaves and woodpiles which may create thick litter is also effective in controlling the spread of the plant. Herbicides may be used as an alternative in heavily infested areas. Spot applications of biodegradable glyphosphate herbicides are recommended before mile-a-minute goes to seed in early August. As glyphosphate is a non-selective herbicide which affects all green vegetation, it should be used sparingly so as not to contact desirable vegetation which may be growing with the mile-a-minute. Professionals should be consulted to determine the best method of control in patches that are heavily infested with this invasive species.

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Invasive Alien Plant Species of Virginia

● Porcelain-berry (*Ampelopsis brevipedunculata* (Maxim.) Trautv.)

Description

Porcelain-berry is a deciduous, climbing vine of the grape family which can grow, with support, to a height of 16 feet. It is related to two North American *Ampelopsis* species, raccoon-grape and pepper-vine. The leaves of porcelain-berry are bright green, slightly hairy on the underside, and often deeply lobed with three to five lobes per leaf. Young twigs are also hairy to the touch. The unusual fruits of porcelain-berry, however, distinguish it from similar species. This fruit is also the feature that may be responsible for its introduction to North America. The fruit is hard, with the appearance of porcelain, and changes in color from white to a series of pastel shades of yellow, lilac, and green before finally turning a sky blue. All the colors can often be found on a single fruit cluster.

Habitat

Porcelain-berry is a hardy species that can adapt to a variety of environmental conditions. It grows well in most soils but is especially successful in moist, slightly shady areas along stream banks, and in thickets.

Distribution

A native of northeast Asia, porcelain-berry was cultivated in North America as an ornamental bedding and screening plant. It spread into natural areas when birds ate the berries and spread the seeds in their droppings. Once established in the wild, this prolific vine spread along the East Coast from New England to North Carolina and west to Ontario and Michigan. Locally, it has been documented in ten counties in northern and central Virginia.

Threats

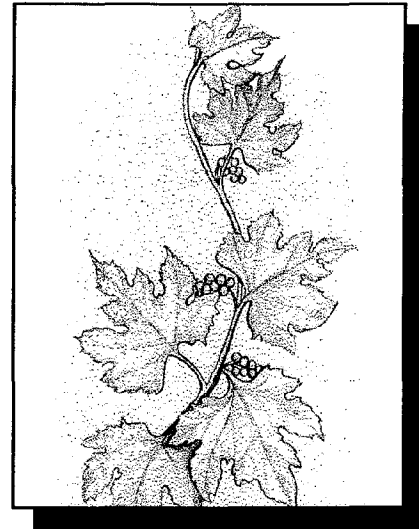
The very features that make porcelain-berry attractive as a landscape plant also make it a problem in natural areas. Although relatively slow to establish, it

grows quickly and, once established, is tenacious and can be difficult to remove. It is relatively insect and disease resistant, and can outcompete native species for water and nutrients. The thick mats of porcelain-berry, which are so attractive to landscapers, spatially usurp other plants.

Control

Surprisingly, this invasive plant is still popular in the horticultural trade. The most effective control is removal from commercial trade and the use of alternative plants for landscaping and gardening. Some alternative species include trumpet honeysuckle, goldflame honeysuckle and jackman clematis.

Where removal of porcelain-berry is necessitated, hand pulling the plants should be done before the plant is in fruit to avoid scattering seeds. Because the roots of porcelain-berry plants often merge with shrubs or other desirable vegetation, this type of manual removal is difficult in well established patches without damaging the desirable vegeta-



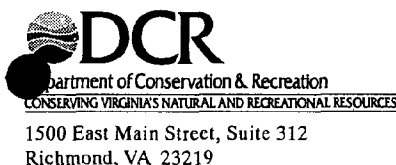
Porcelain-berry (*Ampelopsis brevipedunculata*)

tion as well. If hand pulling is not feasible, porcelain-berry may be removed by the spot application of glyphosphate herbicides to individual plants. As glyphosphate is a non-selective herbicide, it should be used sparingly so as not to contact desirable plants growing with porcelain-berry. Herbicide treatment is most effective when applied toward the end of the growing season when plants are actively transporting nutrients from stems and leaves to root systems. As with manual removal of plants, follow-up treatments may be needed in subsequent years to remove plants which have sprouted from seeds remaining in the soil.

Reference

Spangler, R. L. 1977. Landscape Plants for the Central and Northeastern United States Including Lower and Eastern Canada. Burgess Publishing Company, U.S.A. 506 pp.

For more information, contact the Department of Conservation and Recreation, or the Virginia Native Plant Society.



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Invasive Alien Plant Species of Virginia

Tree-of-Heaven (*Ailanthus altissima* (Miller) Swingle)

Description

Tree-of-heaven is a small to medium-sized tree in the mostly tropical Quas-sia family. It has smooth gray bark. Leaves are compound, alternate, odd-pinnate, with 11-25 lanceolate leaflets. Most leaflets have one to three coarse teeth near their base. Tree-of-heaven leaves may be confused with those of sumac or black walnut. Flowers occur in panicles at the ends of branches; male flowers produce a strong odor which has been described as "the smell of burnt peanut butter." The leaves when crushed also produce this distinctive, offensive odor. Seeds are centered in a papery sheath called a samara. The samaras are slightly twisted or curled, and twirl as they fall to the ground. They can be borne on the wind great distances from the parent plant.

Habitat

Tree-of-heaven establishes itself readily on disturbed sites. These include vacant lots of the inner city, railroad embankments, highway medians, fence rows and roadsides.

In naturally forested areas, disturbance created by severe storms or insect infestations can open the way for tree-of-heaven infestation.

Distribution

Tree-of-heaven is native to a region extending from China south to Australia. It was imported into the United States in 1784 by a Philadelphia gardener. In the western states it was brought over by Chinese immigrants who use it for medicinal purposes. Due to its rapid growth and prolific seed production, it quickly escaped from cultivation.

Threats

One tree-of-heaven can produce up to 350,000 seeds in a year. Seedlings

establish a taproot three months from germination. Thus they quickly outrace many native plant species in competition for sunlight and space. Tree-of-heaven also produces a toxin in its bark and leaves. As these accumulate in the soil, the toxin inhibits the growth of other plants. This toxin is so effective it is being studied as a possible source for a natural herbicide. These factors combine to make tree-of-heaven a very aggressive invasive plant able to displace native tree and herb species. Furthermore, the root system is capable of doing damage to sewers and foundations.

Control

Tree-of-heaven is very difficult to remove once it has established a taproot. It has persisted in certain areas despite cutting, burning and herbiciding. Therefore, seedlings should be removed by hand as early



Tree-of-Heaven (*Ailanthus altissima*)

as possible, preferably when the soil is moist to insure removal of the entire taproot. Larger plants should be cut; two cuttings a year may be necessary, once in the early growing season and once in the late growing season. Initially, this will not kill the plant; it will vigorously resprout from the roots, but seed production will be prevented and the plants will be lowered in stature. If continued over a period of several years, cutting during the growing season stresses the plants and may eventually kill them.

A glyphosate herbicide, either sprayed onto the leaves or painted onto a freshly cut stump will kill the plant. However, to insure the herbicide gets into the root system, it is best to apply this herbicide in the late

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Invasive Alien Plant Species of Virginia

Tree-of-Heaven

growing season while the plant is translocating nutrients to its roots. Glyphosate herbicides are recommended because they are biodegradable, breaking down into harmless components on contact with the soil. However, glyphosate is a nonselective, systemic and will affect all green vegetation. To be safe and effective, herbicide use requires careful knowledge of the chemicals, appropriate

concentrations, and the effective method and timing of their application. Consult a natural resource specialist or agricultural extension agent for more information before attempting herbicide control of tree-of-heaven.

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Appendices:

C. Model Resource Management Plan

COMMONWEALTH of VIRGINIA

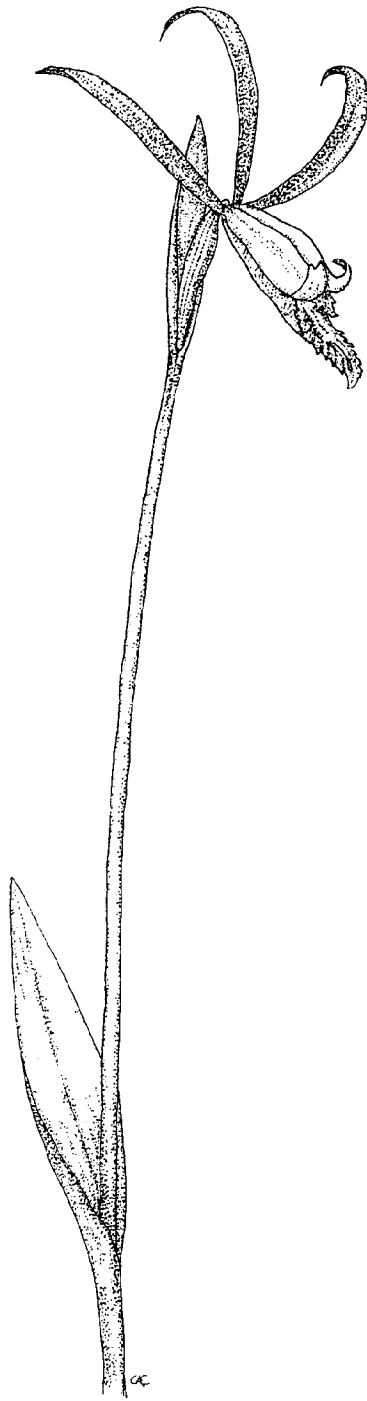
**North Landing River
Natural Area Preserve
Resource Management Plan,
First Edition**

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Spreading Pogonia
Cleistes divaricata

Illustration by Caren A. Caljouw

NORTH LANDING RIVER NATURAL AREA PRESERVE

RESOURCE MANAGEMENT PLAN,

FIRST EDITION

Natural Heritage Technical Document #95-9

15 February 1995

prepared by the
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This management plan was completed with the assistance of the North Landing River Natural Area Preserve Management Planning Advisory Team. Advisory Team members contributed greatly to the development of many components of this management plan and their review of the draft helped produce a useful and polished product. Members of the Advisory Team are listed in Appendix 1.

The principle author of this document is Kennedy H. Clark. Janit Potter drafted the sections regarding recreation and scenic resources. Certain members of the Advisory Team deserve special recognition for their contributions: David Brownlie, Caren Caljouw, Sandra Erdle, Roger Everton, Michael Focazio, Chris Ludwig, Janit Potter, Alan Savitsky, and Robert Rose.

INTRODUCTION

The North Landing River Natural Area Preserve is a system of protected properties along the North Landing River and its tributaries in the cities of Virginia Beach and Chesapeake, Virginia. The preserve consists of 22 tracts totalling over 10,300 acres. It is owned and managed by the Virginia Department of Conservation and Recreation (VDCR) and the Virginia Chapter of The Nature Conservancy (TNC). This management plan follows a format established in the State Lands Resource Management Plan Guide (VDCR 1991) which was developed by the VDCR Land Classification Committee and approved by the Department Director.

PURPOSE OF THE PLAN

The primary purpose of this management plan is to guide the management actions of the natural area preserve through the formulation of goals and objectives and the establishment of management standards. The plan also provides a summary of current knowledge about the site, its resources, and its surroundings. Conservation planning and land classification information is also furnished in the document.

PURPOSE OF THE SITE

The primary purpose for which North Landing River Natural Area Preserve was established is the preservation of natural heritage resources for the benefit of present and future Virginians. Management for the preservation and enhancement of natural heritage resources shall take precedence over all other purposes and management of the preserve. Natural Area Dedication mandates this preservation directive for the site. Natural area dedication is discussed in more detail below.

Secondary purposes for the establishment of the North Landing River Natural Area Preserve include scientific research and environmental education. A tertiary purpose is to provide opportunities for compatible outdoor recreation.

POLICY

VDCR policies for management of natural area preserves are under development. Policies will address such management issues as

prescribed burning, pesticide use, and hunting. TNC has established policies pertaining to the management of TNC-owned property. These policies are currently under review for updating.

NATURAL AREA DEDICATION

Natural area dedication is the strongest form of protection that can be afforded a natural area in Virginia. It involves drafting a legally binding **Instrument of Dedication** which states the preservation purpose of the property, restricts land uses which are incompatible, and formally places the site in the Virginia Natural Area Preserve System. The Instrument of Dedication is recorded with the deed of the property. Dedication is perpetual; ownership of the property can be transferred, but the dedication will remain in effect. Natural area dedication is enabled by the Virginia Natural Area Preserves Act of 1989 (Code of Virginia, section 10.1-209, et seq.).

Three of the 22 tracts that comprise the North Landing River Natural Area Preserve are currently dedicated. The remaining tracts are proposed for natural area dedication and the initial steps have been taken towards dedicating these properties.

PERTINENT NATURAL RESOURCE LAWS

Several natural resource laws may affect the management of the North Landing River Natural Area Preserve. Among the most important are the Virginia Natural Area Preserves Act (Code of Virginia, sections 10.1-209 et seq.), the Federal Clean Water Act (33 USC section 1344), the Virginia Wetlands Act (Code of Virginia, sections 28.2-1300 - 1320), the Federal Endangered Species Act (16 USC sections 1531 -1544), the Virginia Endangered Species Act (Code of Virginia, sections 29.1-230 - 237), the Virginia Endangered Plant and Insect Species Act (Code of Virginia, sections 3.1-1020 - 1030), the National Environmental Policy Act (42 USC sections 4321 - 4307d), and the Virginia Environmental Quality Act (Code of Virginia, sections 10.1-1200 - 1221).

The Virginia Natural Area Preserves Act contains the enabling legislation for the Virginia Natural Area Preserve System and natural area dedication. The Federal Clean Water Act and the Virginia Wetlands Act pertain to the protection of the wetland communities of the preserve. The Federal Endangered Species Act, the Virginia Endangered Species Act, and the Virginia Endangered Plant and Insect Species Act pertain to

species which are listed or proposed to be listed as threatened or endangered at the state or Federal level and provide protection measures for listed species. The National Environmental Policy Act and the Virginia Environmental Quality Act require environmental review of certain projects proposed, funded, or authorized by state or Federal agencies or institutions.

A listing of all Federal and state natural resource laws which could affect the North Landing River Natural Area Preserve or its management is given in Table 1.

PARTNERS IN CONSERVATION PROJECT

Several tracts of the North Landing River Natural Area Preserve (Blackwater Farms, Riganto, Sorey) were acquired through the Partners in Conservation Project. The Partners in Conservation Project was a cooperative endeavor between VDCR and TNC in which TNC contributed 25% of the acquisition costs for natural area preserves purchased by VDCR. Tracts acquired through the Partners in Conservation Project are encumbered with deed restrictions under which they may revert to TNC ownership if not managed appropriately as natural areas. These deed restrictions, in addition to natural area dedication, help to reinforce the purpose of the site.

COOPERATIVE MANAGEMENT

Because of limited resources, VDCR has established a cooperative intra-departmental strategy for the management of natural area preserves. Staff from different divisions of VDCR participate in the management of preserves. The Division of Natural Heritage (DNH) is responsible for coordinating resource management planning and for implementing or supervising ecological management, biological monitoring, and scientific research conducted on natural area preserves. The Division of State Parks (DSP) is responsible for all site operations at VDCR-owned natural area preserves involving site security, visitor use, interpretation, and maintenance of site facilities. DSP also participates in resource management planning and assists DNH with ecological management. The Division of Planning and Recreation Resources (DPRR) provides technical advice to DSP and DNH regarding resource management planning, especially on issues related to public access, recreation, and scenic resources. DNH, DSP, and DPRR share the responsibility of planning, designing, and constructing public access and other facilities

TABLE 1
PERTINENT NATURAL RESOURCE LAWS

LEGISLATION	CITATION	RESPONSIBLE AGENCY
Presidential Order on Introduction of Exotic Species	Executive Order # 11987	Office of the President
U.S. Noxious Weed Law	7 USC 2802-2814	U.S. Dept. of Agriculture
U.S. Clean Water Act	33 USC 1344	U.S. Army Corps of Engineers, U.S. Envir. Protection Agency
U.S. Rivers & Harbors Act	33 USC 404	U.S. Army Corps of Engineers
U.S. Coastal Zone Management Act	16 USC 1451-1464	National Oceanic & Atmospheric Administration
U.S. Anadromous Fish Conservation Act	16 USC 757a-757g	National Marine Fisheries Service
Navigable Waters of the U.S.	14 USC 2	U.S. Coast Guard
U.S. Clean Air Act	42 USC 7401-7671q	U.S. Envir. Protection Agency
Nat. Environmental Policy Act	42 USC 4321-4307d	all Federal agencies
Lacey Act (exotics)	18 USC 42	U.S. Department of Interior
U.S. Endangered Species Act	16 USC 1531-1544	U.S. Fish & Wildlife Service, Nat. Marine Fisheries Service
U.S. Fish & Wildlife Coordination Act	16 USC 661-668s	many
U.S. Migratory Bird Treaty Act	16 USC 701-712	U.S. Fish & Wildlife Service
U.S. Aquatic Nuisance Prevention & Control Act	16 USC 4701-4751	U.S. Fish & Wildlife Service, Nat. Marine Fisheries Service
Vir. Commercial Fishing Law	Vir. Code 28.2-100 - 1001	Vir. Marine Resources Comm.
Vir. Submerged Lands Law	Vir. Code 28.2-1200 - 1213	Vir. Marine Resources Comm.
Vir. Wetlands Act	Vir. Code 28.2-1300 - 1320	Vir. Marine Resources Comm.
Vir. Coastal Primary Sand Dune Act	Vir. Code 28.2-1400 - 1420	Vir. Marine Resources Comm.
Vir. Historic Resources Law	Vir. Code 10.1-2200 - 2216	Vir. Dept of Historic Resources
Vir. Antiquities Act	Vir. Code 10.1-2300 - 2306	Vir. Dept of Historic Resources

TABLE 1 (CONTINUED)

LEGISLATION	CITATION	RESPONSIBLE AGENCY
Vir. Endangered Species Act	Vir. Code 29.1-563 - 570	Vir. Dept. of Game & Inland Fisheries
Vir. Fish & Wildlife Law	Vir. Code 29.1-100 et seq.	Vir. Dept. of Game & Inland Fisheries
Vir. Endangered Plant & Insect Species Act	Vir. Code 3.1-1020 - 1030	Vir. Dept. of Agriculture & Consumer Services
Vir. Noxious Weed Law	Vir. Code 3.1-296.11 - 296.21	Vir. Dept. of Ag. & Con. Ser.
Vir. Chesapeake Bay Preservation Act	Vir. Code 10.1-2100 - 2115	Chesapeake Bay Local Assistance Dept.
Vir. Wildfire & Burning Law	Vir. Code 10.1-1141 - 1142 and 18.2-88	Vir. Dept. of Forestry
Vir. Emissions Law for Open Burning	Vir. Code 120.4-4001 - 400s	Vir. Dept. of Envir. Quality
Vir. Water Control Law	Vir. Code 62.1-44.2 - 44.34	Vir. Dept. of Envir. Quality
Vir. Ground-water Management Act	Vir. Code 62.1-44.84 - 44.104	Vir. Dept. of Environmental Quality
Vir. Environmental Quality Act	Vir. Code 10.1-1200 - 1221	Vir. Dept. of Envir. Quality
Vir. Waste Management Act	Vir. Code 10.1-1400 - 1457	Vir. Dept. of Envir. Quality
Vir. Open Space Land Act	Vir. Code 10.1-1700 - 1705	Vir. Outdoors Foundation
Vir. Erosion & Sediment Act	Vir. Code 10.1-560 - 571	Vir. Dept. of Cons. & Rec.
Vir. Natural Area Preserves Act	Vir. Code 10.1-202 - 217	Vir. Dept. of Cons. & Rec.
Vir. State Scenic Rivers Act	Vir. Code 10.1-400 -418	Vir. Dept. of Cons. & Rec.
Vir. Cave Protection Act	Vir. Code 10.1-1000 - 1008	Vir. Dept. of Cons. & Rec.
Vir. Conservation Easement Act	Vir. Code 10.1-1009 - 1016	Vir. Dept. of Conservation and Recreation
Vir. Shoreline Erosion & Public Beach Law	Vir. Code 10.1-700 - 711	Vir. Dept. of Conservation and Recreation

at a preserve. VDCR's Division of Soil and Water Conservation (DSWC) provides technical advice and other support upon request. The Division of Volunteerism and Constituent Services (DVCS) assists with promotion and interpretation projects. VDCR's cooperative management process is supervised by the Natural Areas Management Team (NAMT). The NAMT is comprised of the Stewardship Director from DNH and the Resource Management Coordinator from DSP. The NAMT coordinates the cooperative management process, works on long-term natural area preserve management issues including planning and project implementation, and endeavors to secure non-general funds for staff support to facilitate management of natural area preserves.

VDCR also turns to resources outside the department to help manage natural area preserves. Other local, state, and Federal government agencies, academic institutions, private conservation groups, and volunteers often assist with the cooperative management efforts of natural area preserves.

In the case of the North Landing River Natural Area Preserve, TNC and VDCR will manage the preserve together. Rather than manage properties independently respective of VDCR or TNC ownership, both TNC-owned and VDCR-owned tracts will be managed through a coordinated TNC-VDCR partnership. The TNC-VDCR partnership will direct management to advance a set of conservation goals mutually agreed upon by both entities.

SITE AND VICINITY DESCRIPTION

LOCATION

The North Landing River Natural Area Preserve is located in the southeastern corner of Virginia between the mouth of the Chesapeake Bay, the Atlantic Ocean, and Currituck Sound. The preserve lies in the southern areas of the cities of Virginia Beach and Chesapeake. The preserve stretches almost 15 miles (24 km) along the North Landing River. The approximate geographic center of the preserve (headwaters of Alton's Creek) lies 20 miles (32 km) southeast of Norfolk and 15 miles south-southwest of the Virginia Beach resort area.

The major north-south arterial roads in the area are Princess Anne Road on the east side of the river and Blackwater Road on the west. Pungo Ferry Road is the only east-west arterial road that crosses the river. Access to or from Interstate 64, approximately 14 miles (22 km) from the preserve's center, can be gained by following Princess Anne Road or other routes northwest. The preserve has a small amount of upland road frontage which lies mostly along Blackwater Road. Water frontage along the North Landing River and its tributaries is plentiful, but nearly all of this frontage is wetland.

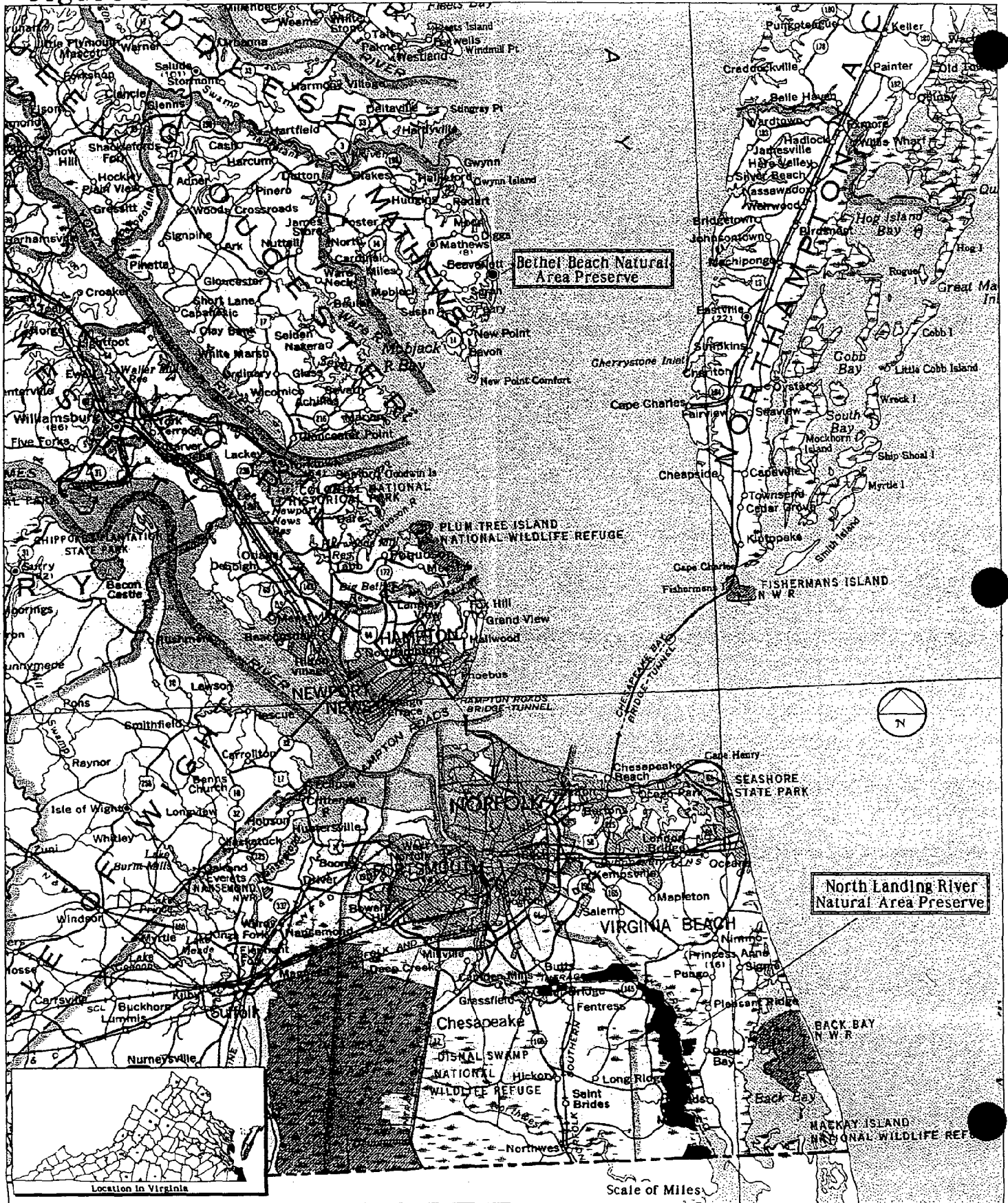
Figure 1 shows the relative location of the preserve in a regional context.

BOUNDARIES

The North Landing River Natural Area Preserve is comprised of 22 tracts. Five tracts are owned or are under negotiation by VDCR and 17 are owned or under negotiation by TNC. Twelve contiguous tracts form an 11 mile (18 km) reach of continuous ownership (by either VDCR or TNC) along the west side of the river. The remaining ten tracts are disjunct. Eight lie on the west side of the river, two on the east side of the river, and three are located along the Chesapeake and Albemarle Canal. Boundaries of these tracts are mapped on Figure 2. Table 2 contains information on each tract.

Some of the preserve boundaries are marked with VDCR or TNC boundary markers, but most of the preserve's boundaries have yet to be marked.

Figure 1. NATURAL AREA PRESERVE LOCATIONS



$$= \frac{1}{\sqrt{\pi}} \int_{-\infty}^{\infty} e^{-t^2} dt = \frac{1}{\sqrt{\pi}} \cdot \sqrt{\pi} = 1.$$


TABLE 2

NORTH LANDING RIVER NATURAL AREA PRESERVE
TRACT INFORMATION

TRACT NAME	ACRES (HECTARES)	OWNERSHIP
Blackwater Farms	1246 (504)	VDCR
Box C Bar	335 (136)	TNC
City of Chesapeake	568 (230)	TNC
Day 1	839 (340)	TNC
Day 2	1100 (445)	TNC
Day 3	107 (43)	TNC
Day 4	104 (42)	TNC
Day 5	188 (76)	TNC
Day 6	14 (6)	TNC
Day 7	.79 (.32)	TNC
Dozier	780 (316)	TNC
Fine	556 (225)	TNC
Gilbert	244 (99)	TNC
Jacobson	88 (36)	TNC
James	25 (10)	TNC
Kellam	45 (18)	VDCR
Miller	400-500 (162-202)	optioned (VDCR)
Riganto	638 (258)	VDCR
Sorey	640 (259)	agreement of intent to purchase (VDCR)
Steinhilber	110 (44)	TNC
Walker	821 (332)	TNC
Woody/Old	1465 (592)	optioned (TNC)
TOTALS	10,314-10,414 (4,174-4,214)	22

Copies of the latest surveys and plats are kept on file at the TNC and VDCR offices, respective of ownership.

Other public lands also occur within the vicinity. The U.S. Army Corps of Engineers (USACE) owns four islands in the North Landing River and long narrow strip along the north bank of the Albemarle and Chesapeake Canal. The City of Virginia Beach owns property on the east shore of the North Landing River (Munden Point Park) and along upper West Neck Creek (proposed to become West Neck Creek Park).

FACILITIES

Facilities currently existing on the preserve are limited. A quarter-mile (400 m) long boardwalk into the marsh of the Dozier tract, built and maintained by TNC, is served by a small gravel parking area off of Blackwater Road just north of its crossing of Milldam Creek. An observation platform, also built and maintained by TNC, is located in the marsh of the City of Chesapeake tract at the confluence of Pocaty Creek and the North Landing River. The platform is accessible only by water. Some informal trails exist on the upland island area of the Blackwater Farms tract.

The Kellam tract was purchased by VDCR specifically to provide public access to the preserve and will be the site of public access facilities in the near future. An access road from Blackwater Road, a parking area, interpretive facilities, a boardwalk, and canoe access to Alton's Creek are in the design stages and should be constructed by the summer of 1995.

Figure 3 shows the locations of these existing and proposed facilities.

Pungo Ferry Road, although not actually part of the preserve (owned by City of Virginia Beach), bisects two of the otherwise contiguous tracts: Blackwater Farms and Riganto.

There are no buildings or structures on the preserve beyond those mentioned above.

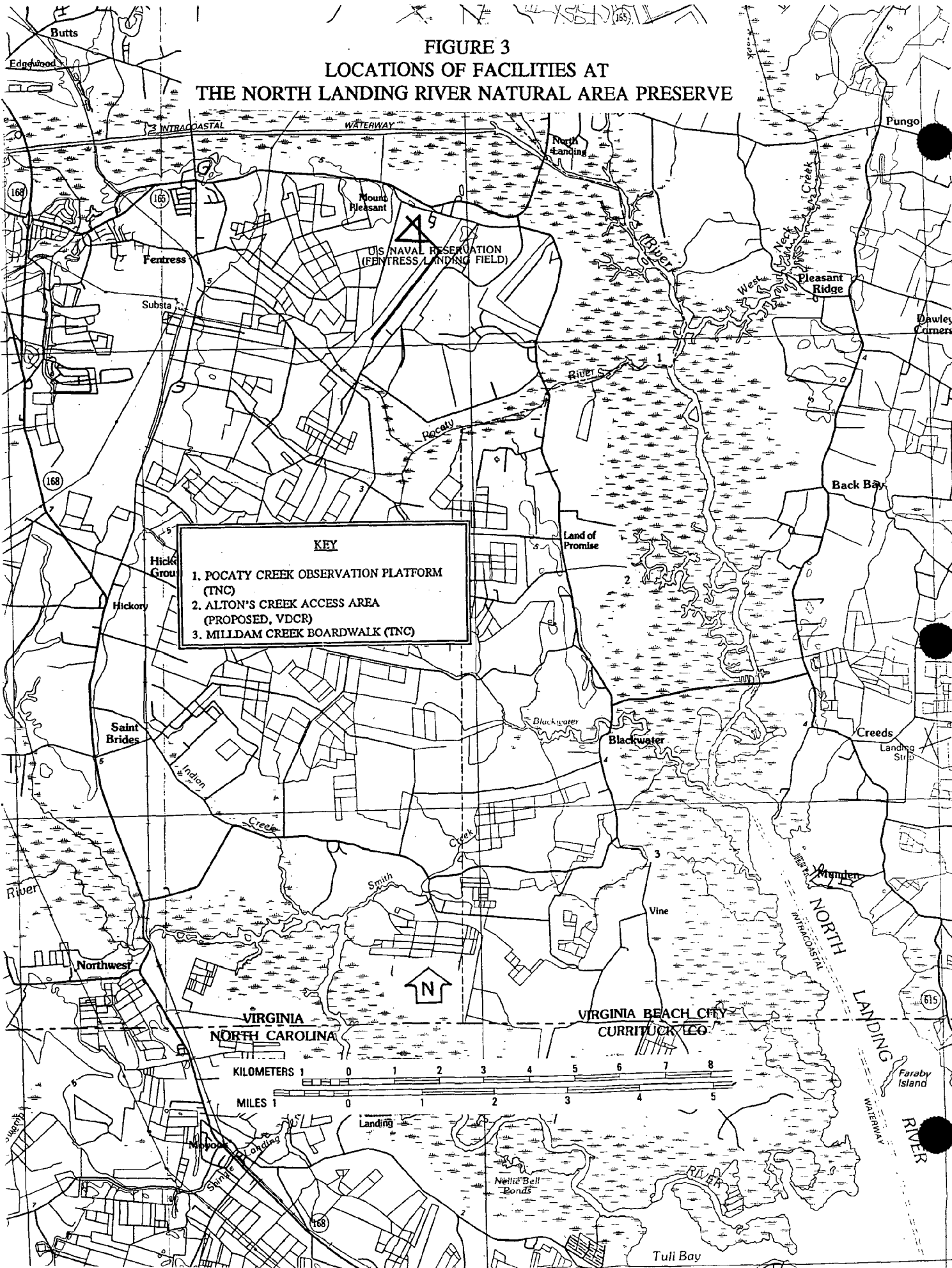
A powerline right-of-way runs through the western part of Day tract number two.

FIGURE 3
LOCATIONS OF FACILITIES AT
THE NORTH LANDING RIVER NATURAL AREA PRESERVE

KEY

1. POCATY CREEK OBSERVATION PLATFORM (TNC)
2. ALTON'S CREEK ACCESS AREA (PROPOSED, VDCR)
3. MILLDAM CREEK BOARDWALK (TNC)

The map shows the North Landing River Natural Area Preserve, including the Intracoastal Waterway, various creeks (Pocaty, Blackwater, Smith, Vine, West), and surrounding areas like Mount Pleasant and Pungo. A scale bar in kilometers and miles is provided at the bottom.



SURROUNDING LAND USE

The area surrounding North Landing River Natural Area Preserve is predominantly rural in character. Areas north of the preserve are heavily urbanized and suburbanized. The preserve vicinity is subject to increasing development pressures, mostly in the form of residential and supporting commercial development.

The North Landing River Watershed encompasses an area of 74,635 acres (30,205 ha) with 2,841 acres (1,150 ha) of which are located in open waters. Agriculture is the primary land use in the watershed, occupying 45% of the land, or 32,633 acres (13,206 ha). Residential uses, commercial buildings, and roadways cover another 12,997 acres (5,260 ha) of the basin or 18% of the land area. The remaining 26,164 acres (10,588 ha) are undeveloped and stand mostly in managed and unmanaged forests.

Agricultural lands consist mostly of row crops. Corn and soybeans are normally rotated and a small grain cover crop is frequently planted in the fall to help minimize soil loss over the winter and early spring. Other agriculture includes market vegetables, pick-your-own berries, hog farms, and horse pasture.

Area farmers are facing a number of pressures in operating their businesses. In order to promote and enhance agriculture as an important local industry, the ad hoc Southern Watersheds Committee has proposed the Virginia Beach Agricultural Reserve Program (ad hoc Southern Watersheds Committee 1994). The ad hoc committee includes representatives from conservation groups, farming and business interests, and local government. The objective of the program is to arrange for the purchase of development rights on farmland in return for working capital that can be reinvested in the farm. Purchased development rights would be held in public trust by the City of Virginia Beach. The program will also endeavor to find crops that will yield high value to Virginia Beach farmers.

Many of the upland forests are managed for fiber production to varying degrees. The Virginia Department of Forestry (VDoF) reported assisting 25 forest landowners with the development of forest management plans for a total of 6,595 acres (2,669 ha) in the cities of Virginia Beach and Chesapeake during the period from 1989 through 1992. Intensively managed stands, which are generally pure loblolly pine, are often subject

to pre-commercial and commercial thinnings, periodic clear-cutting, site preparation through the use of burning and fertilizers, re-seeding or re-planting, and release spraying with herbicides. Most forest stands in the area, however, are managed less intensively. Southern pine bark beetle outbreaks are a concern among foresters and forest owners. Control activities may involve cutting of infested and surrounding trees.

The cities of Virginia Beach and Chesapeake manage the growth and development within the North Landing River Watershed. The City of Virginia Beach includes recommendations for this region in the Pungo/Blackwater Planning Area of the Comprehensive Plan: Planning Commission Recommendations to City Council, December 12, 1990 (City of Virginia Beach 1992). This plan shows much of the area surrounding the North Landing River and its tributaries as "environmentally sensitive areas." The four issues cited in the comprehensive plan of particular relevance for the Pungo/Blackwater Planning Area are:

- (1) rural growth management,
- (2) agricultural preservation,
- (3) rural transportation management, and
- (4) environmental protection.

The existing land use in the Pungo/Blackwater planning area is predominantly agricultural mixed with one to three acre residential lots intermittently located as strip development along the existing roadways. A number of small, rural commercial centers have evolved along Princess Anne Road and Blackwater Road. These centers represent the only concentration of commercial land use in the watershed. A few small subdivisions have been built or are under construction between Princess Anne Road and the river.

The City of Chesapeake includes the area within the North Landing River watershed in the Southern Chesapeake Planning Unit of their comprehensive plan, entitled A Comprehensive Plan for the City of Chesapeake, Virginia (City of Chesapeake 1990). This comprehensive plan was adopted by the Chesapeake City Council on July 25, 1990. According to the plan, the Southern Chesapeake planning unit has three primary functions:

- (1) to sustain agriculture and protect open space,
- (2) to provide for rural residential environments, and
- (3) to provide compatible remote facilities sites for the U.S. Naval

Airfield and the Chesapeake Municipal Airport.

The existing character of the landscape in the Southern Chesapeake Planning Unit is rural with agricultural and residential uses predominating. Existing forested swamps and marshlands also comprise a large area. The comprehensive plan describes the future form of the area south of the Chesapeake and Albemarle Canal in the vicinity of Great Bridge as being a "countryside community," while the southern and western sections of the city are described as rural or environmentally sensitive.

The North Landing River watershed experiences heavy recreational use, especially the waterways themselves. Boating and related activities are the principal recreational uses of the watershed. Fishing, hunting, camping, picnicking, walking, and wildlife observation are also common. Recreation in the North Landing River watershed is discussed in detail in the recreation resources section.

DEMOGRAPHICS

Table 3 summarizes some general demographic information regarding the area.

In the last two decades, the coastal mid-Atlantic region, which includes the North Landing River Watershed, has been growing at one of the fastest paces in the United States. During this time period, the City of Virginia Beach grew faster, by 25 percent, than any other city in the nation.

The preserve lies in the City of Chesapeake and the City of Virginia Beach. The regional context is the Hampton Roads Planning District which includes Isle of Wight County, James City County, Southampton County, York County, Gloucester County, and the Cities of Chesapeake, Franklin, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg.

The 1990 population of Virginia Beach was 393,089 and the projected population for the year 2010 is 579,590. The 1990 population for Chesapeake was 151,982 and the projected population for 2010 is 211,100. The 1990 population of the Hampton Roads Planning District was 1,418,030 and the projected 2010 population is 1,753,113 (Lillywhite and Nieman 1993). The Hampton Roads Planning District has the second greatest population of all 21 Virginia planning districts

TABLE 3
LOCAL AND REGIONAL DEMOGRAPHICS

FEATURE	VIR. BEACH	CHES.	PLAN. DIST.	ALL VIR.
1990 population	393,069	151,976	1,416,443	6,187,200
1990 pop. ages 0 - 19	122,161	47,864	423,509	1,704,600
1990 pop. ages 20 - 59	236,621	86,098	814,163	3,818,200
1990 pop. ages 60 +	34,287	18,014	178,771	664,400
2010 pop. projection	579,590	211,100	1,753,113	7,451,158
1990 per capita income (\$)	17,578	16,775	16,448	15,713

(Northern Virginia PDC is first).

The Pungo/Blackwater Planning Area, which contains the Virginia Beach section of the preserve, is the largest Virginia Beach planning area in terms of acreage, but it has the smallest population. In 1990 the population of this planning area was approximately 4,300. A build-out population cited in the comprehensive plan is 83,900 (City of Virginia Beach 1992). Population growth in the Southern Chesapeake Planning Unit, which contains the Chesapeake portion of the preserve, is anticipated to increase from 14,129 in 1988 to 24,389 in 2002 (City of Chesapeake 1990).

The current foundations of the local economy are tourism, the military, and shipping. Major employers in the Hampton Roads Planning District include the military and other government agencies and the services, retail trade, and manufacturing industries. The economy in the North Landing River watershed, however, continues to be based upon agriculture and forestry (HRPDC 1993).

The per capita income for the Hampton Roads Planning District was \$16,448 in 1990; it was \$15,713 for all of Virginia (HRPDC 1993).

AREA HISTORY

The North Landing River area was home to various groups of Native Americans for at least 9,000 years before European settlers arrived in the early 1600's. The most recent tribe, the Chesapeake, was gradually replaced by English settlers in the first half of the 17th century.

The early colonial landscape of the 1600's was characterized by scattered plantations of varying size with crossroad hamlets and river landings. Tobacco was the first crop in the area and became the center of the colonial economy. Farmers began planting other crops and turning to timber harvest in the 1680's. Market crops, including tobacco, corn, and wheat, were shipped overland to Norfolk, the closest deep-water port. Lower Norfolk County, now the City of Virginia Beach, was established during the early colonial period. The first courthouse for Lower Norfolk County was built in 1661 on Broad Creek. A Baptist congregation began services near Pungo Ferry in 1674 and became what is now Oak Grove Baptist Church, the second oldest Baptist congregation in Virginia.

The early settlements in the county depended on a poorly developed road system for transportation of products to markets. The numerous waterways and wetlands that hindered road development also encouraged the adoption of water as the primary transportation medium in the later 1700's. Agriculture improved in the 1700's and people began building more substantial houses and communities. Several more Baptist churches were established in the area, demonstrating the gradual break from the Church of England in the colonies. Several conflicts of the American Revolutionary War were fought in the vicinity, including the expulsion of the last colonial governor of Virginia, Lord Dunmore, from Norfolk. Farming operations diversified in the 1700's; local crops included corn, oats, wheat, and flax. Trade in pitch, tar, and pork also began.

Water-based transportation dominated the area from the later 1700's into the middle 1800's. Several canals were constructed to link key areas, including the Chesapeake and Albemarle Canal (originally named the Albemarle and Chesapeake Canal). Finished in 1859, the C&A Canal linked the Elizabeth River and points north to the North Landing River and points south. A drawbridge was constructed across the North Landing River at Pungo Ferry Road in the early 1800's, but it was burned during the Civil War. A ferry service replaced the bridge. Several minor American Civil War conflicts were fought in the vicinity including the burning of all the bridges in the area to prevent produce from reaching markets. The still standing Princess Anne Courthouse was established in 1824. By 1835, Princess Anne Courthouse was considered a main commercial center in the area. In 1868, Princess Anne Courthouse became the seat of Princess Anne County, which had been formed from Lower Norfolk County. Hay, poultry, and cattle joined the list of agricultural products. Railroads were constructed in the area in the 1880's and quickly replaced the canals and waterways as the major form of transportation. Settlements, including Pungo and Creeds, grew around the railroad depots.

The 20th Century has been a period of rapid change in the area. Virginia Beach was established as a beach resort before the turn of the century and was granted its town charter in 1906. A new turnstile bridge replaced the ferry service across the river at Pungo Ferry Road by 1920. Princess Anne County was still primarily agricultural in 1925. The county was one of the most productive truck farming areas in the state. Potatoes were the largest crop; other products included apples, peaches, hay, corn, cotton, wheat, and peanuts. Dairy cows and hogs were also

raised in the early 20th century. The railroads in the area closed in the 1940's; farmers began to truck their goods to markets in Norfolk. The City of Virginia Beach was formed from the Town of Virginia Beach and Princess Anne County in 1963 and a city manager form of government was adopted. The City of Chesapeake also was created in 1963 by the merger of Norfolk County and the Town of South Norfolk. The northern parts of Virginia Beach and Chesapeake experienced rapid growth in the 1970's and 1980's, but the southern areas remain rural in character. The C&A Canal is now an important part of the Atlantic Intracoastal Waterway (ICW) linking New England to Florida. The Pungo Ferry drawbridge was replaced by a high profile bridge in 1991. Virginia Beach continues to develop as a vacation destination and resort community.

TNC and VDCR conservation efforts began in the area in 1988. The first component of the preserve, the Riganto tract, was acquired in 1989. Acquisition efforts are continuing in the 1990's. Interest in conservation of both the rural character of the area as well as the outstanding natural resources have lead to several other projects by VDCR, TNC, and a host of conservation partners.

RESOURCES

PHYSICAL AND ABIOTIC FEATURES

TOPOGRAPHY

The topography of the North Landing River basin is low and flat. Low, narrow, well-drained ridges and substantial wetland areas are separated by wide, poorly drained flats. The ridges are generally oriented north-south and average ten feet (3 m) above sea-level with some ridges reaching 30 feet (9 m). The wetland areas generally surround shallow rivers, creeks, and bays.

Most of the preserve is located on riverine wetland areas between the poorly drained flats and the river. Approximately 95 percent of the preserve is below five feet (1.5 m) above sea-level.

GEOLOGY

The North Landing River Natural Area Preserve is located on the Atlantic Coastal Plain physiographic province. The geology of the coastal plain is characterized by layers of unconsolidated sediments over deeply buried bedrock. The bedrock in the North Landing River area is covered by 2000 to 5000 feet (610 - 1,524 m) of sediments. There are no bedrock outcrops. Most of the geology underlying the preserve consists of alluvial, organic-rich clay and silt. The geology of the uplands surrounding the preserve consists of pebbly and cobbly sand grading upward into muddy, fine sand, sandy silt, and silt (DMME 1993).

SOILS

Soils in the area were formed in layers of marine and fluvial sediments. These sediments range in texture from sand to clay. Soils of the wetland areas consist of organic matter and silt. The broad flats contain mostly poorly drained silt loams. The sand component increases on and around the low ridges which consist of moderately well-drained loams and fine sandy loams (Hatch et al. 1985).

According to the Virginia Beach Soil Survey prepared by the Soil Conservation Service (Hatch et al 1985), most of the soils on the preserve itself are either Dorovan mucky peat or Pocaty peat.

Dorovan mucky peat, found in the swamp and pocosin areas, is a deep, nearly level, poorly drained wetland soil. Composition is slightly to well-decomposed organic matter and silt. The soil ranges from extremely acidic through slightly acidic. In the swamps and pocosins, the peat grades downward to a highly decomposed peaty clay that is underlain by fluvial sand and gravel deposits with little organic matter. Surface-water runoff is very slow. This soil type is continuously saturated and frequently flooded.

The Pocaty peat soil type is found in the marshes of the preserve. Like Dorovan, Pocaty peat is deep, nearly level, and poorly drained. Composition is slightly to well-decomposed organic matter with some silt. The soil is moderately permeable and surface-water runoff is very slow. Pocaty peat ranges from strongly acidic to neutral, but may become extremely acidic upon drying or exposure.

CLIMATE

The average winter temperature of the area is 42° F (5.5° C); the average summer temperature is 77° F (25° C). Recorded extreme temperatures are 5° F (-15° C) (1/17/77) and 103° F (39.5° C) (7/23/52). The growing season length averages around 230 days. The date of first freeze is generally in mid-November, the last freeze in late March.

The average total annual precipitation is 45 inches (114 cm). Twenty-five inches (13 cm), or 56 percent, usually falls in April through September, the growing season for most crops. Thunderstorms occur on about 37 days each year; most occur during the summer (Hatch et al. 1985, NOAA 1993).

HYDROLOGY

The North Landing River watershed is part of the Albemarle-Pamlico Estuarine region, the second largest estuarine system in the United States.

As mentioned previously, the North Landing River watershed is on the outer Atlantic Coastal Plain and is distinguished by flat topography and low gradient rivers and creeks. The water table is at or near the surface in much of the watershed, particularly in the riparian areas. The hydrology on and in the vicinity of the preserve is characterized by swamps and marshes draining slowly into sluggish rivers and creeks.

The North Landing River empties into Currituck Sound in North Carolina south of the preserve. Major tributaries to the river, from south to north, include the Northwest River, Milldam Creek, Blackwater Creek, Alton's Creek, Pocaty Creek, West Neck Creek, and the Chesapeake and Albemarle Canal. The North Landing River watershed covers a 74,000 acre (29,947 ha) area, almost 3,000 acres (1,214 ha) of which are open water. The headwaters of the North Landing River are in the area of the Kempsville community in northern Virginia Beach. The amount of net flow is low and to the south.

Surface-water and ground-water levels are most often affected by precipitation and evapotranspiration. Tides may cause extreme, but temporary, fluctuations of water levels in the riparian areas as well as in the water channels. Tides in the area are influenced mostly by wind rather than gravitational effects. Strong winds from the southeast move water into Currituck Inlet and northward up the North Landing River flooding the bordering marshes and swamps. North to west winds will cause low tides. Since wind speed, direction, and duration are irregular, so are frequency, amplitude, and duration of the tides. Extreme high tides will flood even the interior wetlands.

Several major projects have altered the hydrology of the area from its natural state. The Chesapeake and Albemarle Canal was constructed in the 1850's through Gum Swamp to connect the North Landing River to the Elizabeth River. A set of locks at the community of Great Bridge helps prevent the saline waters of the Elizabeth River from reaching the North Landing River in large quantities. As part of the same canal project, a channel was dredged down the North Landing River into Currituck Sound. The dredging operation straightened, widened, and deepened significant portions of the North Landing River. Several short canals were dug cutting off several oxbows and creating marsh islands. The C&A Canal and the North Landing River are now key components of the Atlantic Intracoastal Waterway. A large ditch known as Canal Number Two connects London Bridge Creek, a tributary of the Lynnhaven River, to West Neck Creek, a major tributary of the North Landing River. In 1989, a bypass canal was completed around Canal Number Two for flood control purposes. As a result of this increased hydrologic continuity, saltier water may be intruding into West Neck Creek, but the ecological effects have not yet been determined. Pungo Ferry Road was constructed on top of substantial wetland peat deposits and required extensive dredge and fill operations through the wetland area. Agriculture has affected the hydrology, too. Ditching of the

uplands to enhance drainage of agricultural fields likely has lowered the water table in the fields and changed surface-water run-off patterns.

Ground-water withdrawals in the area are limited by water quality. The ground water increases in salinity with increasing depth. Because of the salinity, the large industrial and municipal withdrawals from deep aquifers found in other parts of the Coastal Plain are absent in the North Landing River watershed. Consequently, ground-water withdrawals are from wells in shallow aquifers and are generally limited to domestic and agricultural uses. These withdrawals are generally small and from confined aquifers underlying, and somewhat isolated, from the water table aquifer. The extent of local effects on water levels in the wetlands is undetermined (M. Focazio, pers. comm.).

WATER QUALITY

The Virginia Department of Environmental Quality's "General Report of All Waterbody Data" (VDEQ 1995) provides recent water quality data for the North Landing River and five of its major tributaries. According to the report, all 77 river miles (124 km) of the waterbody fully support water quality standards for fish consumption and swimming. Water quality standards for aquatic life support also are currently fully supported for all 77 miles (124 km), however, seven miles are considered threatened by urban non-point pollution sources. Drinking water supply goals are fully supported for five river miles (8 km), which includes the entire extent of the waterway utilized for public water supply (Stumpy Lake and tributaries). The report also notes that none of the waterbody is impaired by failure to meet Clean Water Act point and non-point source pollution standards.

The Virginia Department of Environmental Quality (VDEQ) also maintains a network of ambient water quality monitoring stations in the area. Sampling at the monitoring stations is conducted on a monthly to quarterly schedule. Basic field parameters (pH, DO, temperature, salinity, and conductivity) are measured and samples are taken for fecal coliform, nutrients, TSS, BOD, water column metals, and sediment metals. VDEQ has agreed to supply VDCR with a data from this monitoring.

There are six treated wastewater discharges into the North Landing River and its tributaries. The sources of these six discharges are Bergey's Dairy Farm, Mount Pleasant Mennonite Church, Norfolk Dredging Company, Standard Transpipe Virginia, Incorporated, Oceana Naval Air

Station, and Hope Haven - Union Mission.

As mentioned above, the direct connection from the saline Lynnhaven River to the freshwater North Landing River via Canal Number Two has been enhanced by the construction of a bypass canal. This project seems to have resulted in some influx of saltwater into the North Landing River system. The saltwater influx appears to be driven primarily by the wind tides; the highest salinities in West Neck Creek, 24.5 ppt, were observed during periods of sustained, strong northerly winds (Bales and Skrobialowski 1993). The effects of these salt water pulses on the aquatic and wetland plant and animal communities has not been determined.

According to the records of the U.S. Coast Guard (USCG) and U.S. Army Corps of Engineers, 1,364 tons of freight passed through the C&A Canal at the Great Bridge lock in 1992. Of this total, 258 tons were petroleum products and fertilizers. A spill of kerosene-like jet fuel occurred on the North Landing River side of the lock into the canal in June of 1994. Although the extent of this spill turned out to be very minor, the event indicates a potential threat from spills to water quality of the North Landing River system.

The Virginia Nonpoint Source Pollution Watershed Assessment Report (VDCR 1993) prepared by the VDCR's Division of Soil and Water Conservation gives an overall priority rating of high for non-point source pollution in the North Landing River hydrologic unit. Individual "pollution potential" ratings were high for urban-related sources, high for agriculture-related sources, and low for forestry-related sources. The report states that the hydrologic unit containing the North Landing River watershed rates in the top 10% statewide for agricultural non-point source pollution priorities.

The United States Geologic Survey (USGS) is conducting a study of ground water on the preserve and in the vicinity in cooperation with VDCR and TNC. Preliminary results have been collected from a single transect of monitoring wells running from agricultural uplands through the swamp and pocosin into the marsh. These preliminary results indicate that ground-water quality was influenced by agriculture in a shallow well in an agricultural field. However, ground-water quality measured from wells in nearby swamp, pocosin, and marsh appeared not to be influenced by agriculture (M. Focazio, pers. comm.).

Another water quality issue facing the North Landing River is the disposal of dredge spoil from maintenance dredging of the ICW channel in the river. The ICW channel in the reach of the North Landing River just north of the state line is dredged approximately every five years. The dredged material is disposed in the shallow, open-water sites on the west side of the navigation channel from the state line to about two miles (3 km) upriver of the state line. Sedimentation and Sediment Quality in the North Landing River, Currituck Sound Estuarine System (Riggs et al. 1993) prepared by the Albemarle-Pamlico Estuarine Study states, "It is our opinion that open disposal of mud sediments resulting from maintenance dredging of the Intracoastal Waterway channel have previously and will continue to have significant impacts upon turbidity levels of associated estuarine waters for several years after dredging has been completed." Such disposal of dredged material also may re-suspend toxic substances into the water column which had previously settled on the bottom.

OVERVIEW OF NATURAL COMMUNITIES

The North Landing River Natural Area Preserve is part of an interior coastal wetland ecosystem. The preserve is over 85 percent wetland, containing extensive swamp, pocosin, and marsh communities. The wetlands are surrounded by forested or farmed uplands. A more detailed discussion of the natural communities can be found in the conservation planning section of this document.

Several different types of swamp have been identified in the area, the number depends upon the classification scheme utilized. Swampy areas are characterized by such tree species as swamp tupelo (Nyssa biflora), red maple (Acer rubrum), sweetgum (Liquidambar styraciflua), green ash (Fraxinus pennsylvanica), and loblolly pine (Pinus taeda). Bald cypress (Taxodium distichum), pond pine (Pinus serotina), and Atlantic white cedar (Chamaecyparis thyoides) also form components of some of the swamp communities. In some swampy areas, upland islands can be found supporting mesophytic oaks (Quercus spp.) along with loblolly pine.

Deep in the interior of the wetlands, pocosins are found. Pocosins are evergreen shrub-dominated, peat-based wetlands. Dominant shrub species include sheep laurel (Kalmia angustifolia), fetterbush (Lyonia lucida), and inkberry (Ilex glabra). The few, scattered, and stunted trees are mostly of pond pine, red bay (Persia borbonia), and sweet bay

(Magnolia virginiana). Laurel leaved greenbrier (Smilax laurifolia) grows throughout the scrub.

The North Landing River's extensive marshes are fresh to slightly brackish water wetlands. The largest areas of marsh are found on the west side of the river just north of the state line. Common species of the marshes include big cordgrass (Spartina cynosuroides), black needlerush (Juncus roemerianus), common reed (Phragmites australis), several cattail species (Typha spp.), and switchgrass (Panicum virgatum). There are many types of marshes and species richness in some of the marsh types is quite high.

Uplands to the east and west of the preserve crest in a low ridge which slopes gently down into the wetlands. Most of the uplands around the preserve are in crops or forests. Common forest tree species include loblolly pine, oaks, red maple, and sweetgum.

NATURAL HERITAGE RESOURCES

The North Landing River wetlands are rich in biodiversity. Forty-one natural heritage resources have been recently documented from the wetlands and adjacent uplands of the North Landing River Natural Area Preserve. Of the 41, 22 are rare plant species, ten are rare animal species, eight are rare natural communities, and one is a bird nesting colony. In addition, 16 watch-listed species have been recently documented from the area, three of which are animals and 13 are plants. At least 15 other natural heritage resources, mostly rare animal species, have a moderate to high potential to occur in the North Landing River area. Intensive biological survey for these potential natural heritage resources has not yet been completed, but either historic records or existing habitat conditions indicate the possibility that they may occur in the area. Table 4 lists the natural heritage resources along with their rarity ranks and legal status. Definitions of rarity ranks and legal status abbreviations used in Table 4 can be found in Appendix 2.

Much of the natural heritage resource knowledge regarding the North Landing River ecosystem came from a natural areas inventory project conducted by VDCR for the City of Virginia Beach. The goal of the project was to systematically identify the natural heritage resources of the City of Virginia Beach. The project began in 1989 and lasted three years. The multi-step inventory involved review of aerial photographs and gathering of other information, conducting aerial reconnaissance, and

TABLE 4
NATURAL HERITAGE RESOURCES
OF THE NORTH LANDING RIVER NATURAL AREA PRESERVE

COMMON NAME	SCIENTIFIC NAME	RANKS AND STATUS*
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PLANTS

A Yellow-Eyed Grass	<u>Xyris laxifolia</u> var. <u>iridifolia</u>	G3G5T7/S1/NF/NS
Atlantic White Cedar	<u>Chamaecyparis thyoides</u>	G4/S2/NF/NS
Big-Headed Rush	<u>Juncus megacephalus</u>	G4G5/S2/NF/NS
Blue Jasmine Leatherflower	<u>Clematis crispa</u>	G5/S3/NF/NS
Buttonbush Dodder	<u>Cuscuta cephalanthii</u>	G5/S17/NF/NS
Carolina Boltonia	<u>Boltonia caroliniana</u>	G2Q/S2/NF/NS
Carolina Lilaeopsis	<u>Lilaeopsis attenuate</u>	G4G5/S1S2/3C/C
Coastal Plain Aster	<u>Aster racemosus</u>	G3?Q/S1/NF/NS
Elliot's Aster	<u>Aster puniceus</u> var. <u>elliotii</u>	G5T3T4/S2/NF/NS
Elongated Lobelia	<u>Lobelia elongata</u>	G3G5/S1/NF/NS
Epiphytic Sedge	<u>Carex decomposita</u>	G3G4/S1/3C/C
Featherfoil	<u>Hottonia inflata</u>	G3G4/S2/NF/NS
Joint Paspalum	<u>Paspalum distichum</u>	G5/S1/NF/NS
Pretty Dodder	<u>Cuscuta indecora</u>	G5/S27/NF/NS
Sawgrass	<u>Cladium mariscus</u> var. <u>jamaicense</u>	G5T5/S1/NF/NS
Silky Camelia	<u>Stewartia malacodendron</u>	G4/S2/NF/NS
Slender Dragon-Head	<u>Physostegia leptophylla</u>	G4G5/S2/3C/NS
Spanish Moss	<u>Tillandsia usneoides</u>	G5/S2/NF/NS
Spreading Pogonia	<u>Cleistes divaricata</u>	G4/S1/NF/NS
Virginia Least Trillium	<u>Trillium pusillum</u> var. <u>virginianum</u>	G3T2/S2/C2/NS
Walter's Sedge	<u>Carex striata</u>	G4/S1S2/NF/NS
Winged Seedbox	<u>Ludwigia alata</u>	G3G4/S1/NF/NS

TABLE 4 (CONTINUED)

COMMON NAME	SCIENTIFIC NAME	RANKS AND STATUS*
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ANIMALS

Canebrake Rattlesnake	<u>Crotalus horridus atricaudatus</u>	G5/S1/NF/NS
Dismal Swamp Southeastern Shrew	<u>Sorex longirostris fisheri</u>	G5T2/S2/LT/LT
Four-Spotted Pennant	<u>Brachymesia gravida</u>	G5/S2S3/NF/NS
Great Egret	<u>Casmerodius albus</u>	G5/S2/NF/NS
Great Purple Hairstreak	<u>Atlides halesus</u>	G5/S2/NF/NS
King Rail	<u>Rallus elegans</u>	G4Q/S2/NF/NS
Least Bittern	<u>Ixobrychus exilis</u>	G5/S2/NF/NS
Marsh Rabbit	<u>Sylvilagus palustris</u>	G5/S2S3/NF/NS
Scarce Swamp Skipper	<u>Euphyes dukesi</u>	G3G4/S2/NF/NS
Virginia Rail	<u>Rallus limicola</u>	G5/S2/NF/NS

NATURAL COMMUNITIES

Atlantic White Cedar Swamp	Oligotrophic Saturated Palustrine Forest	G3G4/S1
Big Cordgrass Brackish Marsh	Tall Estuarine Herbaceous Vegetation	G5/S5
Cypress - Tupelo Swamp	Eutrophic Semipermanently Flooded Forest	G5/S4
Fetterbush - Sheep Laurel Short Pocosin	Oligotrophic Saturated Palustrine Scrub	G3/S1
Pond Pine - Fetterbush Tall Pocosin	Oligotrophic Saturated Palustrine Woodland	G3G4/S1
Spikerush Short Freshwater Marsh	Short Herbaceous Estuarine Wetland	G7/S1
Open Peat Bog	Oligotrophic Saturated Palustrine Herbaceous Wetland	G7/S7
Bulrush - Cattail Freshwater Marsh	Mid-height Herbaceous Estuarine Wetland	G4/S3

OTHER

Heron Nesting Colony		
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* Appendix 2 contains definitions of the rarity ranks and legal status abbreviations

thorough biodiversity survey fieldwork by botanists, zoologists, and ecologists. The results of the project can be found in A Natural Areas Inventory of the City of Virginia Beach, Virginia (Clampitt et al. 1993).

Each of the eight rare natural community types is discussed below. The community nomenclature found in the Biological Conservation Datasystem (BCD) is used in this discussion. The discussion of all 32 rare species, subspecies, or varieties is beyond the scope of this document. Therefore, ten "key rare species" have been selected for detailed discussion. The species were chosen to be representative of as many of the habitats and taxonomic groups as possible. The key rare species are Atlantic white cedar, canebrake rattlesnake (Crotalus horridus atricaudatus), Carolina lilaeopsis (Lilaeopsis attenuata), Dismal Swamp southeastern shrew (Sorex longirostris fisheri), elongated lobelia (Lobelia elongata), epiphytic sedge (Carex decomposita), least bittern (Ixobrychus exilis), scarce swamp skipper (Euphyes dukesi), spreading pogonia (Cleistes divaricata), and Virginia least trillium (Trillium pusillum var. virginianum). Key rare species are also discussed below.

SPIKERUSH SHORT FRESHWATER MARSH (Short Herbaceous Estuarine Wetland)

The North Landing River wetlands contain outstanding examples of several different freshwater to slightly brackish marsh types, three of which are natural heritage resources. The **spikerush short freshwater marsh** is perhaps the most significant of the three. This type is found in the interior marshes, away from open water channels. Subject to less tidal action than the fringing marsh types, the spikerush short freshwater marsh is therefore also poorer in nutrients. Ground-water seepage and peat-doming may be factors in this marsh type. Species richness is characteristically high in the spikerush short freshwater marsh (up to 29 species per 100 square yards) and determination of dominant species can be difficult. As the name implies, one or more species of spikerushes (Eleocharis spp.) are almost always found in this marsh type. Other frequently encountered species include any of several umbrella sedges (Cyperus spp.), several bulrushes (Scirpus spp.), twigrush (Cladium mariscoides), and sawgrass (Cladium mariscus var. jamaicense). The spikerush short freshwater marsh is also often home to rare plant and insect species. The variety of community classification systems in use and the paucity of inventory data make it difficult to ascertain the actual global range and rarity of this marsh type, though it is thought to be uncommon. In Virginia, however, the community is found only in the

wetlands of Back Bay, the North Landing River, and the Northwest River. Because of its restricted distribution and limited occurrences, the spikerush short freshwater marsh is considered very rare in the Commonwealth. This community can be threatened by pollution, alteration of the hydrologic regime, and direct destruction through draining or filling. Problem species such as common reed and nutria (Myocastor coypus) also may threaten this community.

BULRUSH - CATTAIL FRESHWATER MARSH (mid-height herbaceous estuarine wetland)

The second rare marsh type is the **bulrush - cattail freshwater marsh**. Like the spikerush short freshwater marsh, the bulrush - cattail freshwater marsh is generally located away from the edges of channels, but may be close to the channels in some instances. This marsh type is generally somewhat richer in nutrients than the spikerush short freshwater marsh. Stands of southern cattail (Typha domingensis) and narrow-leaved cattail (Typha angustifolia) are common along with several bulrush species. Camphorweed (Pluchea foetida), pickerelweed (Pontederia cordata), arrow arum (Peltandra virginica), duck potato (Sagittaria latifolia), smartweeds (Polygonum spp.), and spikerushes are also frequently encountered. This marsh type is uncommon throughout its range and rare in Virginia. This community can be threatened by pollution, alteration of the hydrologic regime, and direct destruction through draining or filling. Problem species such as common reed and nutria also may threaten this community.

BIG CORDGRASS OLIGOHALINE MARSH (tall estuarine herbaceous vegetation)

Another marsh type found on the North Landing River Natural Area Preserve is the **big cordgrass oligohaline marsh**. This community is strongly dominated by big cordgrass and may also contain components of the bulrush - cattail freshwater marsh along with other species such as black needlerush, switchgrass, and sawgrass. Big cordgrass marshes are often found at the edges of the river, its creeks, and guts. The nutrient regime is rich. Although a common natural community both globally and within Virginia, the North Landing River marshes contain some of the largest and most pristine stands of big cordgrass in the state. The big cordgrass oligohaline marshes therefore qualify as exemplary natural communities and are considered one of the Commonwealth's natural heritage resources. This community can be

threatened by pollution, alteration of the hydrologic regime, and direct destruction through draining or filling. Problem species such as common reed and nutria also may threaten this community.

ATLANTIC WHITE CEDAR SWAMP
(oligotrophic saturated palustrine scrub)

Atlantic white cedar swamps are another rare natural community found in wetlands of the North Landing River. Atlantic white cedar swamps range along the Atlantic and Gulf coasts of the United States from Maine to Mississippi. Atlantic white cedar is distributed disjunctly through its range; many neighboring populations are separated by vast distances. The presence of Atlantic white cedar trees does not necessarily constitute an occurrence of the Atlantic white cedar community. Only a handful of Atlantic white cedar swamps have been documented in Virginia. Atlantic white cedar swamps, restricted to freshwater coastal wetlands, are declining over much of their range. The community is considered rare to uncommon globally and extremely rare in Virginia. Atlantic white cedar also is considered a rare species in Virginia and may be found as scattered individuals throughout the wetlands of the North Landing River. The Atlantic white cedar community, however, is characterized by swamps strongly dominated by the species or even in pure stands. Most Atlantic white cedar swamps are dependent upon fire for regeneration. Infrequent, intense fires burn away old trees and most all other vegetation. This opens up habitat for seedlings which do not compete well with adult trees or other species. Then, there must be a long period of no fire while Atlantic white cedar seedlings become established, mature, and produce seed. Atlantic white cedar swamps tend to grow up in pure, even-aged stands. The fire return interval ranges from 50 to 100 years. Atlantic white cedar swamps can be threatened by pollution, alteration of the hydrologic regime, lack of fire, and indiscriminate logging.

POND PINE - FETTERBUSH TALL POCOSIN
(oligotrophic saturated palustrine woodland)

Pocosins are evergreen shrub wetlands found on thick peat deposits. Virginia is the northern edge of the range for pocosins which are distributed on the Atlantic Coastal Plain from southeastern Virginia into Florida and west into the Gulf coastal states. Pocosins are globally rare natural communities and are extremely rare in Virginia. Two pocosins on the west side of the North Landing River are the only known pocosins in

Virginia that remain hydrologically intact. Other, more disturbed, but quite expansive, examples of the community can be found in the Great Dismal Swamp. Pocosins can be extremely nutrient-poor. Peat accumulation, continuously wet, acidic soils, low nutrient conditions, and fires are important factors in formation and maintenance of pocosins. Threats to pocosins include pollution, lack of fire, peat mining, logging, and alteration of the hydrologic regime.

Pocosins are generally broken down into three sub-types. **Pond pine - fetterbush tall pocosins** contain evergreen shrubs over three or four feet (1 - 1.2 m) in height. Common shrub species include fetterbush, inkberry, and sheep laurel, but tall pocosins also have a strong component of sweet bay, red bay, wax myrtle (Myrica cerifera), Atlantic white cedar, and pond pine.

FETTERBUSH - SHEEP LAUREL SHORT POCOSIN
(oligotrophic saturated palustrine scrub)

Fetterbush - sheep laurel short pocosins contain the same shrub species, but the shrubs are usually less than three or four feet (1 - 1.2 m) in height. Fetterbush - sheep laurel short pocosins also have fewer trees. Trees that do occur in short pocosins are predominantly stunted pond pines with a few Atlantic white cedars.

OPEN PEAT BOG
(oligotrophic saturated palustrine herbaceous wetland)

A third variation of pocosins, the **open peat bog**, occurs in the North Landing River watershed as scattered, small remnants. Either great amounts of peat accumulation and the consequent extremely poor nutrient availability, frequent fires, or a combination of both cause the shrub component to be all but eliminated from a bog. Ferns (Pteridophyta), peat mosses (Sphagnum spp.), and sedges (Carex spp.) dominate the resultant boggy area. Several rare species, such as spreading pogonia, are also found in this rarest of pocosin types.

CYPRESS - TUPELO SWAMP
(eutrophic semipermanently flooded forest)

The **cypress - tupelo swamp** is a fairly common natural community which has outstanding occurrences in the North Landing River wetlands. This

swamp type is characterized by bald cypress and water tupelo (Nyssa aquatica). Other possible tree species include swamp tupelo, ashes, red maple, and sweet gum. This swamp type tends to border upper reaches of the river and its tributaries; it may form a narrow fringe or a broad expanse. Alteration of the hydrologic regime, indiscriminate logging, and filling or draining constitute the principal threats to this community.

VIRGINIA LEAST TRILLIUM
(Trillium pusillum var. virginianum)

The **Virginia least trillium** has been recently documented from one site in the preserve and could potentially be found in other areas. This small three-leaved plant in the lily family bears white to pink flowers in the early spring. Virginia least trillium grows primarily in somewhat acidic moist to saturated soils, although it does not grow in standing water. The plant is most often found on the margins of swamps, on high spots within swamps, or in ground-water seepage areas. The range of Virginia least trillium includes southeastern Virginia, northeastern North Carolina, and disjunct areas in the mountains of western Virginia and eastern West Virginia. Virginia least trillium is rare throughout its range and is very rare in Virginia, where it is known from only eight counties. The plant is listed as endangered in North Carolina and is a candidate for the Federal endangered species list. Direct destruction of individuals, loss of habitat, and alteration of water quantity are the principle threats to the species.

DISMAL SWAMP SOUTHEASTERN SHREW
(Sorex longirostris fisheri)

The **Dismal Swamp southeastern shrew**, a small mammal of the insectivore order, is a subspecies of the southeastern shrew characterized by a body size significantly larger than the average for the species. Though the species ranges throughout the Southeast, the Dismal Swamp southeastern shrew is apparently restricted to an area roughly equal to the historical extent of the Great Dismal Swamp and vicinity, which includes the North Landing River watershed. Presence of the subspecies has been documented from the cities of Suffolk, Chesapeake, and Virginia Beach. The Dismal Swamp southeastern shrew is currently considered rare in Virginia and throughout its small global range of southeastern Virginia and northeastern North Carolina. The subspecies is listed as threatened at both the federal and state levels. The Dismal Swamp southeastern shrew is approximately four

inches (10 cm) in total length with reddish-brown fur, small eyes, hidden ears, and a long snout. Dismal Swamp southeastern shrews inhabit a wide variety of habitats with substantial leaf litter or other ground cover where they hunt for their invertebrate prey. The principle threats to this subspecies are habitat fragmentation and destruction.

EPIPHYTIC SEDGE **(Carex decomposita)**

The **epiphytic sedge**, also known as cypress-knee sedge, is a one to three foot tall slender-leaved plant that grows primarily in tussocks on the bases of trees (especially bald cypress), cypress knees, or downed logs in the edges of swamps. The epiphytic sedge usually is found in undisturbed, organic-rich backwaters. It is a perennial species that bears its fruit in early summer. At one time the range of this species included a large area of the east coast and midwestern states, but in recent years its range has shrunk considerably. It is now found in somewhat disjunct locations in the Southeast. In Virginia, epiphytic sedge is known only from the North Landing and Northwest River wetlands. The species is considered globally rare to uncommon and extremely rare in the state. It is a candidate for listing as threatened or endangered at the state level. Epiphytic sedge is threatened by degradation of water quality, alteration of hydrologic regime, and direct habitat destruction.

SCARCE SWAMP SKIPPER **(Euphyes dukesi)**

The **scarce swamp skipper**, also known as the brown sedge skipper or Duke's skipper, is a medium-sized butterfly appearing sooty black on top and pale brown underneath; females have several orange spots on the upper wing surface. Females lay their eggs on the undersides of leaves of specific sedge species. The larvae are dependent upon these host sedges. The scarce swamp skipper utilizes both the swamp and marsh habitats where it can find nectar and its host sedges. The species is distributed in a few widely separated locations throughout the East. In Virginia, the scarce swamp skipper is known from five sites, all in the North Landing and Northwest River wetlands. The species is very rare in Virginia and rare to uncommon throughout its range. It is a candidate for listing as threatened or endangered at the state level. The species is primarily threatened by habitat destruction, especially the elimination of the host sedge species.

ELONGATED LOBELIA

(Lobelia elongata)

Also known as the purple lobelia, the **elongated lobelia** is a rare plant of the marshes. This two to four foot tall, purple-flowered, narrow leaved, herb of the lobelia family is often found in the spikerush short freshwater marshes or the bulrush-cattail freshwater marshes. This species is found on the Atlantic Coastal Plain from Delaware to Georgia. Because the elongated lobelia is known only from the marshes of Back Bay, the North Landing River, and the Northwest River in Virginia, it is considered very rare in the state. Destruction or alteration of its wetland habitat is the major threat to elongated lobelia.

SPREADING POGONIA

(Cleistes divaricata)

The **spreading pogonia** ranges across the Southeast. In Virginia, the species is documented from only eight sites in six counties and is considered extremely rare. Spreading pogonia is a delicate orchid that grows up to two feet (60 cm) tall and has one stem which bears a single oblong leaf and usually one pink flower. This plant grows in bogs, flatwoods, and other low-nutrient, open wetlands. The habitats in which spreading pogonia is usually found are generally fire dependent. The North Landing River Natural Area Preserve, where the plant is found in the open peat bogs, is no exception. Alteration or destruction of its wetland habitat, including that caused by a lack of fire, is the principle threat to spreading pogonia.

ATLANTIC WHITE CEDAR

(Chamaecyparis thyoides)

As noted above in the Atlantic white cedar swamp discussion, **Atlantic white cedar** is a very rare species in Virginia. The tree is known from 12 sites in Virginia, eight of which are in Virginia Beach and the remainder in three other coastal plain counties. In addition to occurring in several nearly pure stands which comprise occurrences of the rare natural community, Atlantic white cedar can be found in small groups or as scattered individuals in the pocosins and lower-nutrient swamps of the preserve. Logging, fire suppression, and water quantity alteration are the main threats to this species.

CAROLINA LILAEOPSIS

(Lilaeopsis attenuata)

An aquatic species of the carrot family, **Carolina lilaeopsis** grows in quiet shallow water or mud at the marsh's edge. The plant has slender rhizomes or creeping stems from which grow clusters of four to 12 inch long, spoon-shaped leaves. The leaves typically grow into tangled mats. Diminutive white flowers bloom from short-stalked umbels. Carolina lilaeopsis ranges on the Atlantic Coastal Plain from Virginia through north Florida; it is considered common to uncommon globally. In Virginia, the species is very rare, occurring at nine sites, all within the City of Virginia Beach. It is a candidate for listing as threatened or endangered at the state level. Direct destruction of habitat and plants from boat wakes as well as degradation of water quality or alteration of water quantity are threats to this species.

CANEBRAKE RATTLESNAKE

(Crotalus horridus atricaudatus)

The **canebroke rattlesnake**, the only rattlesnake in southeast Virginia, can grow to over four feet (1.2 m) in length. Adults have black chevron-shaped markings on a yellow, tan, or gray ground color. The subspecies is found in a wide range of habitats, including both upland and wetland forests. Canebrake rattlesnakes prey mainly on gray squirrels and to a lesser extent upon other mammalian species. The subspecies' range includes the southeastern Atlantic Coastal Plain from southeastern Virginia to eastern Texas. Canebrake rattlesnakes have been documented from at least ten sites in the Commonwealth, but they are all limited to the cities of Chesapeake, Virginia Beach, Suffolk, and Newport News, and the County of York. Although the subspecies is globally common, it is extremely rare and limited in distribution in Virginia, prompting its listing as a state endangered species. Destruction and fragmentation of habitat and killing and capture by humans are the principle threats to the species.

LEAST BITTERN

(Ixobrychus exilis)

Least bitterns nest throughout the marshes of the North Landing River. Because there are only thirteen known breeding sites for the species in just eight counties in Virginia, least bitterns are considered very rare in the Commonwealth. The species is more common in some other parts

of its breeding range, which includes most of the eastern United States. Least bitterns are small wading birds, distinctively tan and white underneath and greenish black on the crown and back. Least bitterns nest and forage in fresh to brackish water marshes, especially those containing stands of cattails. The birds nest solitarily or semi-colonially, building their nest in tall marsh vegetation or small shrubs in the marsh. Least bitterns forage for small fish, frogs, tadpoles, slugs, leeches and other small animals in shallow water, mud, or marsh vegetation. Least bitterns are shy and secretive; they will "freeze" in a reed-like pose if approached to avoid detection. Habitat loss or alteration are the primary threats to the species. Disturbance of nesting, foraging, or resting behavior by human activities can also be a threat.

WATCH-LIST AND POTENTIAL

Some examples of watch-list species which occur in the preserve include the southern bog lemming (Synaptomys cooperi helaleetus), harlequin darter (Gonphaeschna furcillata), sheep laurel, American frog's-bit (Limnobia spongia), and southern twayblade (Listera australis). Examples of rare species which have a potential to occur on the preserve include Hessel's hairstreak (Mitoura hesseli), bald eagle (Haliaeetus leucocephalus), barking treefrog (Hyla gratiosa), Dismal Swamp green stinkbug (Chlorocroa dismala), and eastern big-eared bat (Plecotus rafinesquii). Several rare species are known from the area only in historic records, but also have potential to be rediscovered on the preserve. An example is large cranberry (Vaccinium macrocarpon).

More detailed information regarding the occurrences of all 41 natural heritage resources in the North Landing River Natural Area Preserve can be found in the natural heritage inventory report (Clampitt et al. 1993).

HISTORIC RESOURCES

The Virginia Department of Historic Resources has no records for archaeological sites, historic buildings, or other historic features on the North Landing River Natural Area Preserve. This does not mean that historic resources do not exist on the site; the lack of information may be a reflection of a lack of survey for historic resources. Considering that the preserve is almost entirely wetlands, however, it is likely that little pre-historic or historic use of the preserve occurred.

Because development pressures have been relatively low in southern

Virginia Beach and Chesapeake, many of the historic structures remain. Princess Anne Courthouse, Dawley Meetinghouse, Pungo Inn, Nimmo United Methodist Church, and the Ives farmhouse are examples of historic structures which can be found in the area. The City of Virginia Beach has prepared several recent inventories of historic buildings and sites in the city. Over 200 historic buildings are listed in the Blackwater, Pungo, and Princess Anne burroughs which contain the preserve. Several properties in the area have the potential for listing on the National Register of Historic Places.

RECREATION RESOURCES AND PUBLIC ACCESS

Providing compatible outdoor recreation opportunities is one of the purposes for the establishment of the North Landing River Natural Area Preserve. **The management needs of natural heritage resources will always take priority over the demands for outdoor recreation at this site.**

In 1993, VDCR conducted an assessment of public access on the North Landing River and its tributaries published as North Landing River Watershed Public Access and Visual Assessment (Potter et al. 1994). Refer to that report for detailed public access information, including maps of existing and proposed facilities in the area.

NEED FOR OUTDOOR RECREATION OPPORTUNITIES

There is a definite need for additional public access to outdoor recreational opportunities throughout the Commonwealth. Access to water-related recreation is especially in demand in Virginia and demand for low-intensity recreational activities associated with natural areas (birding, nature photography, etc.) is increasing, as well (VDCR 1994). The increase in demand for both low-intensity outdoor recreation and water-related recreation amplifies the need for access and recreation opportunities at natural areas. Nature-based tourism is a young, but expanding, industry in the City of Virginia Beach that will further intensify this need.

EXISTING RECREATION

Most existing outdoor recreational activities in the North Landing River area are water-related, but many other forms are also popular. Motor-boating, waterskiing, jetskiing, boat fishing, bank fishing, and canoeing are among the most popular water-related recreation. Sailing, kayaking,

swimming, rowing, and board-sailing also occur on the North Landing River or its tributaries. Other recreational activities not directly related to water which occur in the North Landing River area include hunting, trapping, camping, picnicking, hiking, birding, nature study, sun-bathing, and photography. Because the preserve is almost entirely wetlands, most recreation occurs outside the site's boundaries.

As part of the Atlantic Intracoastal Waterway, the main channel of the North Landing River is subject to high traffic volumes of large recreational and commercial vessels. The main channel of the North Landing River is not suitable for canoes and other small non-motorized watercraft. Tributary waters of the North Landing River lack the heavy traffic of large motorized boats and are enjoyed by smaller power boats and non-motorized watercraft. Canoe access exists along most of these tributaries; however, many existing access do not provide trip opportunities or trails which do not involve back tracking.

Deer hunting is a popular activity among many local residents in the area. Although some area hunters prefer the solitude of tree-stand hunting, many are members of a hunt club which hunt in groups. Deer hunting is not currently allowed on the VDCR tracts, but hunting guidelines are under development that will likely allow deer hunting for resource management purposes. Hunting rights were retained by a few of the previous owners of some TNC tracts; deer hunting occurs on those tracts in accordance with the terms of the property transfer. Duck hunting is allowed in the City of Virginia Beach only from floating blinds. TNC and VDCR work in cooperation with the Virginia Department of Game and Inland Fisheries (VDGIF) to establish and maintain duck hunting guidelines for the waters adjacent the preserve.

Camping on the preserve itself is not allowed, but there are two campgrounds in the vicinity of the preserve. In addition to the boardwalk on the Dozier tract, hiking and walking are enjoyed at several parks in the area. Picnicking and other activities also occur at these parks and campgrounds. Bicycle routes do not currently exist in the vicinity of the preserve; roads in the vicinity are typically two-lane rural routes with minimal shoulders.

POTENTIAL RECREATION

The lands and waters in the North Landing River area offer tremendous opportunities for development of low intensity recreational opportunities.

The North Landing River could be considered a key component of a water-oriented greenway or trails system. The river is already designated as both a Virginia Scenic River and a Virginia Beach Scenic Waterway and Canoe Trail. The Virginia Beach Outdoors Plan (City of Virginia Beach 1994) suggests water as a unifying theme for outdoor recreation in the city. Within the city's projected plans for future development are the Landstown-Pungo Trail and the West Neck Creek Linear Park, both located near West Neck Creek. These planned parks and facilities will enhance the greenway and multipurpose trail opportunities in the area. Future road improvement projects in this area could include the addition of bikeways and pedestrian facilities, canoe access at bridge crossings, and scenic or interpretive waysides.

EXISTING ACCESS

As part of the Atlantic Intracoastal Waterway, the North Landing River is accessible from the metropolitan Norfolk area via the Southern Branch of the Elizabeth River and from North Carolina via Currituck Sound. There are six boat ramps open to the public along the North Landing River. One of these ramps is located in a publicly-owned park; the remainder are privately operated. Sites in the area which offer boat ramp access include West Neck Creek Marina, Mercer Boat House, Pungo Ferry Marina, Blackwater Trading Post, Bradley's Creek Landing, and Munden Point Park. Additionally, tributaries can generally be accessed by canoes from bridge crossings, but formal access facilities do not exist at these sites. Some water access sites offer other activities. For example, some marinas have picnicking areas or a swimming beach. Facilities which compliment use of the waterways by boaters exist throughout the watershed. These facilities include bait and tackle shops, convenience stores, and small restaurants.

The Nature Conservancy has constructed an observation platform at the confluence of the North Landing River and Pocaty Creek on the City of Chesapeake tract (see Figure 3). The ten-foot tall platform is accessible only by canoe or other shallow draft vessels. The tower provides a view of parts of the North Landing River and Pocaty Creek as well as the associated marshes and swamps. The tower is a destination point in an interpretive canoe trail beginning at the Blackwater Road crossing of Pocaty Creek. Canoeists must plan to backtrack to Blackwater Road for take-out of canoes.

Just north of the crossing of Blackwater Road over Milldam Creek, The

Nature Conservancy has constructed a small gravel parking area and a boardwalk over the marsh on the Dozier tract (see Figure 3). Parking is available for approximately six cars and visitors can view the extensive southern marshes of the preserve from the quarter-mile-long boardwalk. The facility is maintained mostly by volunteers. The site is designed for short-term day use only and has no restrooms or other amenities.

Two local parks, Munden Point Park and Northwest River Park, are located close to the preserve. Another local park, West Neck Creek Park, has been proposed for the vicinity. Additionally, Seashore State Park lies only 12 miles (19 km) north of the preserve. Parks can serve as major access points, provide a variety of leisure and recreational activities, and serve as focal points for special events.

Munden Point Park, located on the east shore of the North Landing River, has a boat ramp, picnicking areas, a playground, and fishing areas. Northwest River Park, less than five miles (8 km) west of the preserve, offers a full range of outdoor activities including camping, canoeing, hiking, and interpretive programs. Seashore State Park, Virginia's most visited state park, also offers a variety of outdoor recreation and interpretive programs. Seashore State Park serves as a contact point for dissemination of information regarding the preserve.

Augmenting the facilities and activities at these publicly-owned parks, Seneca Campground, a private facility located off Princess Anne Road, offers camping, a swimming pool, picnic areas, and many amenities.

POTENTIAL ACCESS

Additional small boat access could be provided at various road crossings of the waterways. This would increase public access to the waters for small boats, while minimally impacting surrounding lands. Parking lots or informal roadway pull-offs near or adjacent to the bridge crossings are recommended. Perhaps a public-private partnership could be established at some locations to provide appropriate parking.

The Kellam tract was purchased by VDCR specifically to provide an area for increased public access to the North Landing River Natural Area Preserve. Completed plans include an access road to the site with bus facilities and a boardwalk which leads from the parking area to a canoe launch deck at Alton's Creek. Other site amenities include educational and interpretive signage, opportunities to view the landscape, and picnic

areas.

A 12-acre parcel located north of Pungo Ferry Road on the west side of the river may provide a public access site. The tract is currently in private ownership. The property is bounded on the west by the preserve, on the south by Old Pungo Ferry Road, on the east by the North Landing River, and on the north by Alton's Creek. Although public use of Old Pungo Ferry Road on the west side of the river was discontinued at the opening of the new Pungo Ferry Bridge, the old road has been retained by the City of Virginia Beach to provide the current owner access to the property. The parcel was originally purchased as a marina site. Three boat slips were dredged, but further construction was never implemented. The City of Virginia Beach has expressed some interest in acquiring this site to provide public access to the North Landing River and Alton's Creek. Such an access area also could be utilized as an educational or interpretive area for the preserve.

Two potential problems face the conversion of the tract into a public access area. Vehicle entrance and exit is a safety concern. The intersection of the old road and new road is close to the western downgrade of the Pungo Ferry Bridge. Site security also is a concern at this location. The site is visible from the roadway, but because it is not located in a populated area and there are no adjacent neighbors, the potential exists for vandalism, after-hours use, and maintenance problems. The management of the site could incorporate a public-private partnership. A contracted concessionaire could provide services, equipment, and a permanent presence on the site.

The Old Pungo Ferry Road site has been identified as a critical site for public access development in the North Landing River Watershed Public Access and Visual Assessment (Potter et al. 1994). The tract could provide a launch for canoes and other small, non-motorized boats to Alton's Creek via one of the existing boat slips. Upstream on Alton's Creek, the Kellam tract would serve as a canoe takeout or destination point. This type of access is greatly needed in this part of the North Landing River watershed. Other activities appropriate for this site may include motorized boating access to the North Landing River via a boat ramp on the bank of the river. Picnicking, nature observation, and interpretive facilities could also be incorporated into the site development. Because waterskiing and other motorized boating activities are popular in this vicinity, signage or regulation of motorboat activity may be needed to provide safe passage up Alton's Creek for canoes.

LINKING EDUCATION AND RECREATION

Environmental education programs and interpretive facilities in conjunction with public access and recreation opportunities are vital to building support and increasing understanding of natural areas and their value.

The opportunity to educate boaters regarding the significance of the watershed should be considered a priority. Information could be disseminated to boaters by providing brochures or other educational materials at the various boater retail and service locations. Cooperative efforts to establish exhibits and educational materials could be pursued with other agencies and organizations, such as the Virginia Department of Game and Inland Fisheries, the Virginia Marine Resources Commission, and the Virginia Department of Health.

Environmental education and interpretation opportunities are numerous within the watershed. Natural areas may serve as outdoor classrooms through the use of interpretive signs, self-guided tours, on-site kiosks and development of interpretive brochures. Areas conducive for hiking, nature study, photography, bird watching, and canoeing are important to these types of low-intensity recreational interests.

RECOMMENDATIONS

A recreation and scenic resources sub-committee of the Management Planning Advisory Team met during the planning process to discuss recreation and public access. The sub-committee submitted the following recommendations:

- * Hunting on the preserve should be based on the VDCR and TNC hunting policies and the resource management needs of the property.
- * Public access should be prioritized based on the ability to concentrate use in appropriate areas and avoid widespread diverse use throughout the system.
- * Appropriate limits on access and compatible management of visitors should be achieved through careful planning and development of access areas. Limited parking

areas and support facilities on a site will ultimately restrict the number of people able to use the site at any given time. Well-designed visitation management tools such as signage or boardwalks can direct the visitors to appropriate areas. Reservation systems could be implemented to appropriately control access by large groups.

* Some water-related activities are more appropriate on the main river channel; some activities are better suited to the tributaries. Table 5 shows a listing of water-related activities and recommendations for the appropriateness of each activity on either the main channel or tributaries. Water use zones and restrictions along the waterways should be developed to avoid use conflicts and to direct appropriate use in ecologically sensitive areas. [Note: VDCR and TNC do not regulate boat use of the North Landing River or its tributaries; VDGIF, USACE, and USCG would be necessary partners in any initiative designed to regulate use of the waterways.]

* The location of public access sites should be selected carefully to integrate appropriately the ecological needs of the preserve with the needs of recreationists. Also, compatibility of adjacent land use and activities should be considered.

* A regional cooperative effort should be initiated to encourage appropriate public access and use of the North Landing River Natural Area Preserve and vicinity.

Objectives 12A and 12B address the hunting issues (see Management Direction section). Other recommendations are addressed in Objective 14B, which calls for a comprehensive access and recreation plan.

SCENIC RESOURCES

The identification and protection of visual or scenic resources are often not considered during management planning because of the perceived subjectivity in evaluating the resources. It is important, however, that scenic resources become an integral part of environmental protection and

TABLE 5
WATER-RELATED RECREATION
AND RECOMMENDED WATERBODIES

ACTIVITY	RECOMMENDED FOR MAIN CHANNEL	RECOMMENDED FOR TRIBUTARIES
Motorboating	*	
Waterskiing	*	
Jet Skiing	*	
Canoeing		*
Kayaking		*
Rowing		*
Sailing	*	*
Boat Fishing	*	*
Bank Fishing	*	*
Board-sailing	*	*

conservation efforts.

VALUE OF SCENIC RESOURCES

An awareness of the visual environment or scenic resources is key to the protection of the environment, particularly in the conservation of natural areas such as the North Landing River Natural Area Preserve.

The overall importance of scenery is becoming more of a concern as citizens become more aware of the quality of their environment. Landscape Aesthetics, A Handbook for Scenery Management (USFS 1994) states the need for the conservation of natural appearing landscapes is increasing because of the following:

- expansion of urban population,
- rapid advance of technology and its influence on lifestyles,
- increased demands for goods and services,
- complexity of people's lives,
- amount of land being developed into urban landscapes, and
- disappearance of natural appearing landscapes.

Comparative studies of people under stress and people in recreational settings show that natural landscapes and scenic quality have a positive effect on the psychological and physiological well-being of humans (USFS 1994). These research findings support the theory that high quality scenery benefits human wellness and productivity despite the absence of a dollar value being placed on scenic resources.

Further information regarding the importance of preserving scenic resources can be found in the Draft 1995 Virginia Outdoors Plan (VDCR 1994).

The North Landing River and its tributaries also have been identified in the Virginia Beach Outdoors Plan (City of Virginia Beach 1994) as an area in which the city would like to encourage nature-based tourism.

The popularity of this type of recreational activity, and the subsequent success of nature-based tourism as a commercial endeavor, is dependent upon the appearance of the environment as a natural landscape.

SCENIC RESOURCES OF THE PRESERVE AND VICINITY

There is a direct correlation between ecological significance of the preserve and scenic qualities of the landscape within the area. If the ecological quality of lands within the watershed is maintained, it is very likely that the overall scenic value of the area will also be conserved.

The watershed provides a marvelous natural setting and should be preserved to maintain the visual integrity of the region. The natural landscape of the marshes and swamps is not often encroached by development. The primary scenic features of the area are the river, its tributaries, and the surrounding riparian areas. As long as the wetland vegetation and forests along the riparian areas are retained, the visual integrity of the corridor should be maintained.

Along the North Landing River and its tributaries, "viewsheds" (parts of the landscape visible from a given observation point) may be categorized as from the land towards the water or as from the water towards the land. Most viewing of the area is from the water by the many people involved in boating or other water-related recreational activities.

From the water, the visual experience usually includes the wetlands and the water channel itself. The viewsheds from the water vary depending on the vegetation type nearest the shoreline. Evidence of suburban or urban development is minimal along the North Landing River and its tributaries. Generally, alteration of the landscape is evident only at road crossings and in the few areas where wetlands and do not lie directly adjacent to the waterways.

Views to the water from the land are limited to public park, preserve, or water access areas and bridge crossings. The numbers of bridge crossings and the type of land adjacent to the shoreline further limit opportunities for views from the land to the water. Along the North Landing River and its tributaries there are approximately eight bridge crossings of various water bodies.

The Munden Point Park in the City of Virginia Beach offers an expansive view of the North Landing River to its visitors. The Nature

Conservancy's boardwalk at Milldam Creek provides viewing of the marsh and Milldam Creek. The observation tower provides for viewing of the confluence of Pocaty Creek and the North Landing River and the associated riparian areas. Also, the proposed improvements at Alton's Creek on the Kellam tract will offer views of interior marsh areas and the upper reach of Alton's Creek.

STATE SCENIC RIVER

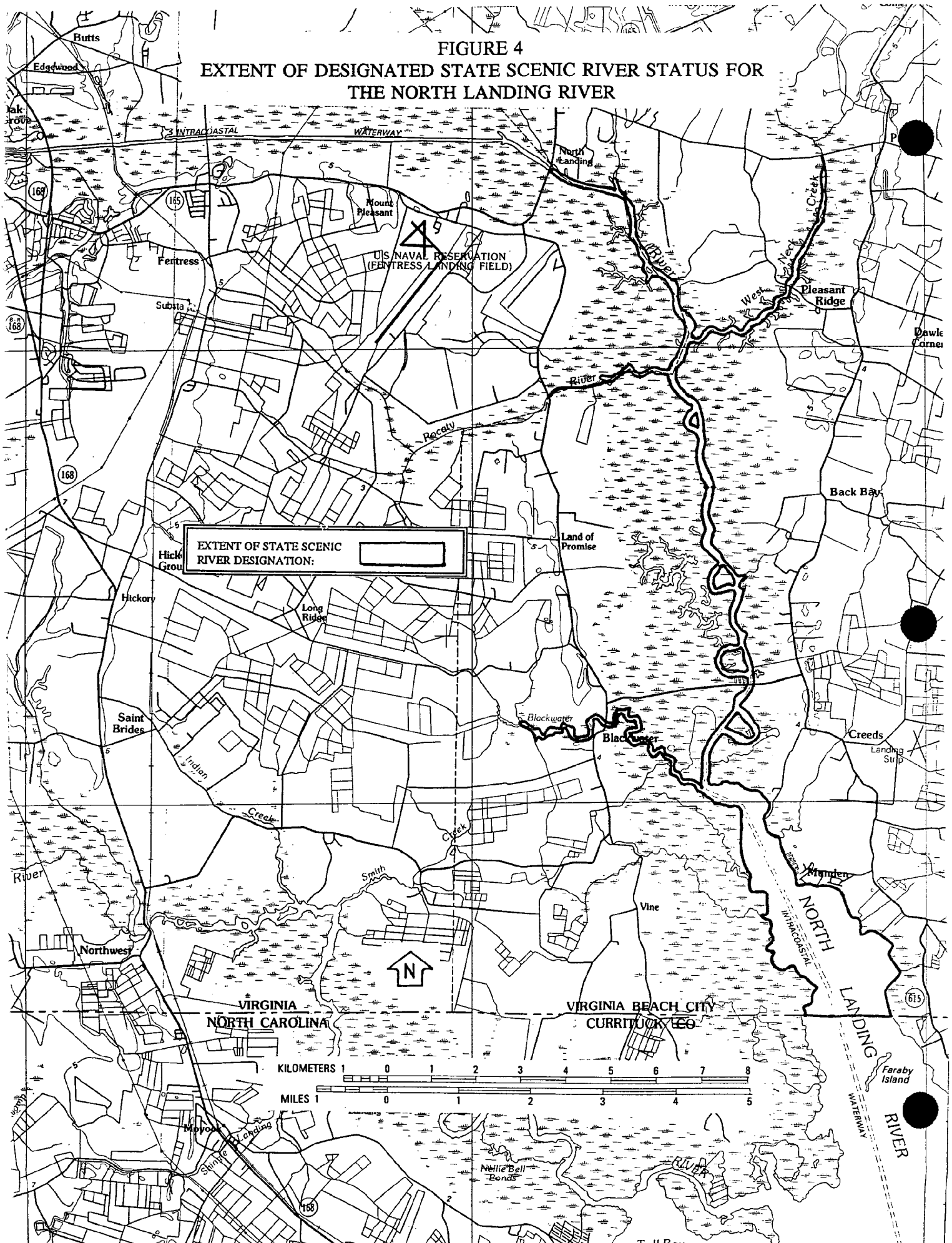
The North Landing River and its tributaries have been designated a state and local scenic resource according to the Virginia Scenic Rivers Act (Code of Virginia, sections 10.1-400 - 418). The river was evaluated and included as a Virginia Scenic River in 1988 by the Virginia General Assembly. Its status as Virginia Scenic River recognizes the unique scenic and cultural resources along the waterway. The Act provides formal recognition, but does not establish scenic buffers or restrictions on visual intrusion to the river. Also, a five member Advisory Board is appointed by the Governor of Virginia to advise local and state agencies regarding issues of relevance to the river's status as an important scenic resource for the Commonwealth. Figure 4 shows the extent of the designated state scenic river.

The Intracoastal Waterway is an important resource for commerce and recreation along the eastern seaboard. The numbers of boats using the North Landing River as part of the ICW make the perceived scenic value of the waterway especially significant.

VISUAL ASSESSMENT OF RIVER AND TRIBUTARIES

The North Landing River is predominantly surrounded by flat terrain. This topography limits the viewshed from water to land and from land to water based on the existing shoreline vegetation. From the headwaters to the North Carolina state line, the western banks of the North Landing River are predominantly protected conservation lands. The extent of these conservation properties from the water inland averages one mile (1.6 km). Vegetation, particularly forested areas, is generally the limiting factor on sight distances both from the land and from the water. The eastern banks of the North Landing River do not contain as many protected conservation lands and there are a few visual intrusions which impact the visual quality along the river. North of West Neck Creek the forested swamp forms only a narrow band along the river's eastern shoreline, if it is present at all. Housing, which can be seen from this

FIGURE 4
EXTENT OF DESIGNATED STATE SCENIC RIVER STATUS FOR
THE NORTH LANDING RIVER



part of the river, has not incorporated a scenic buffer into the development.

Because the extent of marsh increases in the southern section of the river, the visual impression of the river is different from the northern reach. A visual change is perceptible as one travels south of the Pungo Ferry Bridge. The river widens and a feeling of openness increases as one progresses toward the North Carolina state line. Again, in the southern part of the river corridor, the marsh adjacent to the river is narrower on the eastern banks. Also, there are fewer protected conservation lands on this side of the river. Limited housing and other development is visible in that area from the river.

One tributary of the North Landing River, Pocaty Creek (also known as the Pocaty River), varies from very open at its mouth where it meets the North Landing River to a very dense, closed corridor in its upper reaches. The lower section of the creek includes TNC lands on both the southern and northern banks. This area of Pocaty Creek will obviously be protected; however, the area west (up-river) of the TNC lands are vulnerable to visual change due to the narrow width of the creek and the limited extent of swamp on either side.

West Neck Creek is a part of the City of Virginia Beach Waterways system as well as a part of the designated State Scenic River. This waterway is canoed frequently by local residents who enjoy the natural appearing landscape along the creek corridor. While this water body is very close to existing and expanding developments, there is little visual evidence of the development from the water. The upper portions of West Neck Creek give a very enclosed visual impression. Near the confluence with the North Landing River, the vegetation changes such that, south of West Neck Road, the viewshed becomes more open. This area also contains more bald cypress and includes stands of Atlantic White Cedar.

Alton's Creek is lined mostly by marshes. The marshes and its winding character give this creek a sense of visual vastness. The adjoining tidal marshlands allow extended views over the waterway. In fact, when traversing this winding stream, the glimpses of the North Landing River and landmarks along its waterway often serve as reference points in the visual landscape. For example, at several points along the creek, grain silos on the east shore of the North Landing River and the Pungo Ferry Bridge are visible. Overall, this stream provides tranquil views of the

natural landscape with few interruptions due to human activity on the land.

Visually, Blackwater Creek along with West Neck Creek may be the most interesting of the North Landing River tributaries. There is a distinct difference in the swamp located in the uppermost reaches of the river and the marshes east of Blackwater Road. The creek is winding west of Blackwater Road, featuring many "oxbows," which adds to its visual interest. Also, few visual intrusions related to human activities interrupt the natural environment which creates this attractive landscape. The conservation lands along Blackwater Creek protect the visual integrity of the creek.

The marshes of Milldam Creek are similar visually to Blackwater Creek. Most of the creek flows through the vast southern marshes of the North Landing River with no evidence of human activity apparent. Even in the upper reaches, little development exists adjacent to this stream making the views true to the natural environment.

RECOMMENDATIONS

The following specific recommendations regarding scenic resources resulted were made by the recreation and scenic resources sub-committee of the Management Planning Advisory Team:

- * Scenic preservation measures should be developed for the waterways that reach beyond the boundaries of the preserve. A local or regional scenic resources management plan, scenic buffers, and scenic easements may be considered. The east shore of the upper reaches of the river, Pocatoy Creek west of Blackwater Road, Blackwater Creek west of Blackwater Road, and West Neck Creek are in special need of these protective measures. Cooperative programs with Back Bay and Great Dismal Swamp National Wildlife Refuges and the State of North Carolina should be pursued to provide regional continuity in protecting scenic landscapes.

- * Because there are few viewing opportunities for pedestrians and vehicles, pulloffs from bridges which cross the various water bodies should be encouraged by local governments. Construction of future facilities and the replacement of existing bridges should incorporate visual access from the bridge by using a design which has an

open rail bridge parapet.

- * A designation for locally significant byways in the vicinity of the preserve could enhance viewing opportunities. Wayside pull-offs with interpretive facilities or scenic vistas could be developed in cooperation with the Virginia Department of Transportation and the local governments.

- * The Agricultural Reserve Program, if passed by the City of Virginia Beach, also could help retain the scenic resources of the area.

- * The City of Chesapeake's cluster provision may encourage the retention of scenic areas and landscapes.

- * The disturbance and visual impact of boat wakes along the waterways should be addressed. A literature search of how other states manage boat wakes in sensitive areas should be conducted. Users of the waterway should be made aware of potential impacts to the shoreline and its scenic value by boat wakes.

- * Plans with local units of government to encourage clean-up of scenic areas should be continued where they exist and plans for expansion explored. Two annual events which focus on waterway and shoreline clean-up include "Clean the Bay Day," sponsored by Clean the Bay Day, Incorporated, and the "International Coastal Clean-up," sponsored by the Center for Marine Conservation.

- * A GIS overlay district for the river corridor and the area visible from the water to the land could be developed at the request of the localities.

CONSERVATION PLANNING

Conservation planning is an analysis of the ecological, economic, and social features of a landscape and development of a science-based strategy for conservation of natural areas and natural heritage resources. Well formed conservation plans include a description of the natural heritage resources and their conservation needs, an assessment of stresses on the natural heritage resources, and conservation planning boundaries designed to attenuate these stresses and facilitate the long-term survival of the natural heritage resources. Conservation plans often also include ecological models and protection and stewardship recommendations.

Extensive site conservation planning for the North Landing River area, including the protected tracts, was recently completed by VDCR as part of a conservation planning effort for the natural areas of the City of Virginia Beach. The purpose of the study was to provide information to facilitate well-informed planning and wise land use decisions by the City and other public and private land managers. Conservation Planning for the Management and Protection of Natural Areas in the City of Virginia Beach (Erdle et al. 1994) contains the results of the study. There are nine natural heritage resource sites or "natural areas" in the North Landing River ecosystem. The conservation planning report contains conservation plans for seven of the natural areas. Each conservation plan contains information regarding the location, biodiversity rank, general site characteristics, natural heritage resources, management recommendations, protection recommendations, recreational, scenic, and education recommendations, and an assessment of information needs. Additionally, conservation planning boundaries are mapped and explained for each site. The remaining two sites will be covered in a supplemental document.

The following section contains discussions that summarize and augment the information contained in the site conservation plans already completed for the North Landing River ecosystem. For additional conservation planning information, refer to the conservation planning report.

THE ECOSYSTEM

The preserve is a component of a greater ecosystem including the entire

North Landing River watershed. This ecosystem is, in turn, part of a still greater ecosystem involving the entire Albemarle and Pamlico estuary and its drainage basin. **The North Landing River Natural Area Preserve is not an isolated system.** Land use and natural events at local, regional, continental, and even global scales contribute to the status of the preserve. For this reason, conservation planning is conducted at least on a local ecosystem scale.

For purposes of this plan, the North Landing River ecosystem is delineated by the surface watershed. The extent of the ecosystem is shown in Figure 5.

BIODIVERSITY SIGNIFICANCE

Every natural area that VDCR studies, regardless of scale, is assigned a biodiversity significance rank, or "B-rank," which indicates the site's relative significance in terms of biological diversity on a five point scale. B-ranks are derived primarily from an analysis of the rarity ranks and occurrence ranks of all natural heritage resources known from a site. General definitions for the five possible B-ranks are as follows:

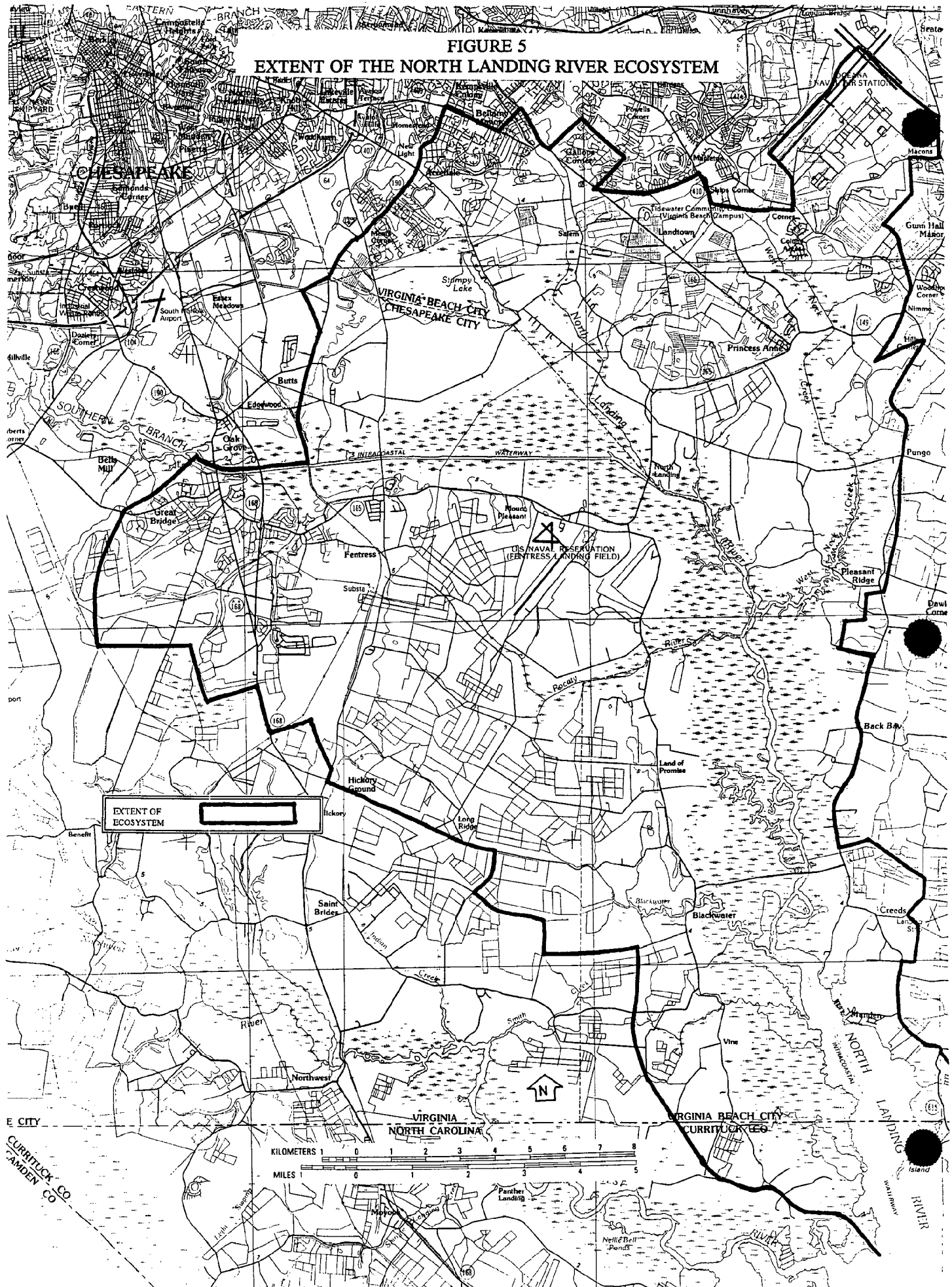
- B1 outstanding significance
- B2 very high significance
- B3 high significance
- B4 moderate significance
- B5 general significance

The North Landing River ecosystem ranks at **B2**. Though only one of the nine natural areas delineated in the ecosystem ranks at **B2** with the remainder at **B3**, **B4**, or **B5**, the ecosystem is very significant for its concentration of such a large number of natural heritage resources, its relatively undisturbed character, and its ecological value to other permanent and transient biota. The conservation planning report contains a breakdown of B-ranks for seven of the natural areas contained within the ecosystem.

CONCEPTUAL ECOLOGICAL MODEL

A conceptual ecological model of the North Landing River ecosystem has been developed by a sub-committee of the Management Planning Advisory Team. A conceptual ecological model is a general representation in words, pictures, or both of the structure and function

FIGURE 5
EXTENT OF THE NORTH LANDING RIVER ECOSYSTEM



of an ecosystem. Conceptual ecological models do not contain the extensive quantification found in mathematical or computer models.

The primary purpose of developing the conceptual ecological model is to enhance our understanding of the ecosystem with general predictive capabilities and thus help guide management actions in a direction that will reach the management goals. The model helps us understand what identify what can be affected with management and what factors. It helps to set management priorities, guides management actions, and allows measures of success to be established. In addition to guiding management, the model also serves several important secondary roles. First, the process of developing the model, a team effort, was a learning experience. Not only did experts of different fields benefit from learning from others, but potential future management partners also learned to work together. Second, the model not only summarizes what we do know about the ecosystem, it also helps to more clearly define what is not known. Questions are formulated and refined. Research and monitoring priorities are identified. Third, since it was developed through team effort, the model represents a consensus of the structure and function of the ecosystem among the key experts and resource managers. Finally, the conceptual ecological model is a powerful communication tool. It can be used to explain the ecosystem and management needs and also leaves a record of knowledge, assumptions, and questions for future managers of the preserve.

The development of a conceptual ecological model is a continuous process. New information from scientific research or other changes in our understanding of the ecosystem will lead to revisions or perhaps even a complete overhaul of the model. This fact is especially true of the North Landing River ecosystem where so many gaps in the knowledge of the hydrology, fire regime, and biota exist. The model presented here should be considered only the first iteration in a series of many.

STRUCTURE OF THE ECOSYSTEM

The principal building blocks in the structure of an ecosystem are its natural communities. The natural communities of an ecosystem can be classified in many ways. The classification system for the North Landing River ecosystem presented here is a composite of several classification schemes. The system is designed to be useful for the conceptual ecological modeling and natural area management efforts. The ecosystem structure is addressed at two hierarchical levels: classes and

associations. The North Landing River ecosystem contains six classes and 19 associations. Information regarding the classes and associations can be found on Table 6.

CLASSES

For purposes of this model, classes are determined by abiotic factors as well as general vegetation type. The class nomenclature is based loosely on community classification systems developed in A Classification of Virginia's Indigenous Biotic Communities: Vegetated Terrestrial, Palustrine, and Estuarine Community Classes (Rawinski 1992) and Classification of Wetlands and Deepwater Habitats in the United States (Cowardin et al. 1979). The six classes are **terrestrial, woody palustrine wetland, herbaceous palustrine wetland, herbaceous estuarine wetland, woody estuarine wetland, and aquatic**. There is a bias in the degree of detail in the delineation of certain classes and their associations. There is only one aquatic and one terrestrial class, but there are four wetland classes. Further, aquatic and terrestrial classes are broken into only a few associations each, but the wetland classes have many associations. This bias is simply a reflection of the focus of the model; the model is designed primarily to aid management of the North Landing River **wetlands**. Further detail in the aquatic and terrestrial classes is considered unnecessary at present, but may become a focal point with future revisions of the model.

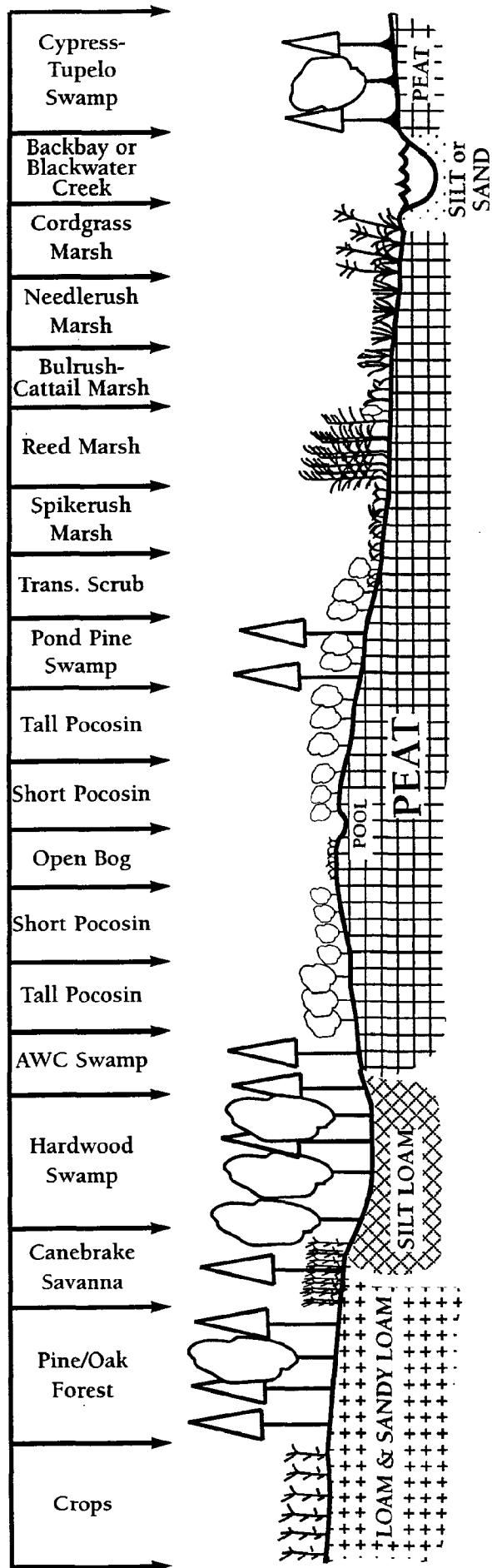
ASSOCIATIONS

Associations are the basic systematic unit used in the conceptual ecological model. Associations are meant to represent an assemblage of species that commonly occur together in the ecosystem and can be delineated in the field by an ecological manager. Of course, associations rarely have discrete boundaries and continuous transitions from one association to another are common. As with the classes, there is a bias towards the delineation of the wetland associations such that they are divided into finer units than the upland or aquatic associations. Association nomenclature is based upon dominant or common vascular plant species. A "common name" is also given for each association for convenience in discussion. Figure 6 shows a diagrammatic profile of the North Landing River ecosystem with the general relative positions of the associations depicted. Key rare species are also addressed at the association level. Some of the rare species may be restricted to only a single association for their entire life cycle, while others may occupy

Table 6 – Components of North Landing River Ecosystem

Class	Association	Common Name	Rawinski X-Ref	Location	Soils	Hydrology	Nutrients	Fire Regime	Key Rare Species
Terrestrial	Corn – Soybean	Crops		Occupies Most of Upland	Loams & Sandy Loams	Moderately Well-Drained to Poorly Drained	Eutrophic	Some Wildfire, Pres. Burning	Canebrake Rattlesnake
	Loblolly Pine – White Oak	Pine/Oak Forest		Sometimes Present b/w Crops & Swamp	Loams & Sandy Loams	Moderately Well-Drained to Poorly Drained	Submesotrophic	Some Wildfire, Pres. Burning	Canebrake Rattlesnake, Dismal Swamp Shrew
	Red Maple – Sweetgum – Blackgum	Hardwood Swamp		b/w Uplands & Peat Wetlands	Organic-Rich Silt Loams	Temporarily to Semi-Permanently Flooded	Eutrophic to Submesotrophic	$\overline{\text{FRI}} = 100+$ Yrs.	Canebrake Rattlesnake, Dismal Swamp Shrew, Vir. Least Trillium
Woody Palustrine Wetland	Atlantic White Cedar – Red Maple	AWC Swamp		Can Be in Peat-Based or Non-Peat-Based Forested Wetlands	Peat or Organic-Rich Silt Loams	Saturated to Seasonally Flooded (?)	Oligotrophic	$\overline{\text{FRI}} = 26$ –100 Yrs.	Atlantic White Cedar, Canebrake Rattlesnake,
	Pond Pine – Red Bay – Sweet Bay	Pond Pine Swamp		Interior Wetlands	Peat	Saturated to Seasonally Flooded (?)	Oligotrophic	$\overline{\text{FRI}} = 13$ –100 Yrs.	Atlantic White Cedar, Canebrake Rattlesnake,
	Fetterbush – Red Bay – Pond Pine	Tall Pocosin		Interior Wetlands	Peat (Thinner Peat?)	Saturated to Seasonally Flooded (?)	Oligotrophic	$\overline{\text{FRI}} = 13$ –25 Yrs.	Atlantic White Cedar, Canebrake Rattlesnake,
Woody Palustrine Wetland	Sheep Laurel – Inkberry – Fetterbush	Short Pocosin		Interior Wetlands	Peat (Thicker Peat?)	Saturated to Seasonally Flooded (?)	Oligotrophic	$\overline{\text{FRI}} = 3$ –10 Yrs.	Atlantic White Cedar, Canebrake Rattlesnake,
	Wax Myrtle – Red Maple	Transitional Scrub		Ecotone b/w Marsh & Pocosin or Swamp	Peat or Silty Peat	Temporarily to Semi-Permanently Flooded	Eutrophic to Submesotrophic	?	Canebrake Rattlesnake
	Switchcane – Pond Pine	Canebrake Savanna		Poorly-Drained Uplands or Higher Wetlands	Silt Loams	Poorly Drained to Seasonally Flooded	Submesotrophic	$\overline{\text{FRI}} = 3$ –25 Yrs. Shorter $\overline{\text{FRI}}$ Pure Cane, Longer $\overline{\text{FRI}}$ Cane w/ Trees	Canebrake Rattlesnake, Dismal Swamp Shrew, Vir. Least Trillium
Herbaceous Palustrine Wetland	Walter's Sedge – Virginia Chain Fern	Open Bog		Interior Wetlands	Peat (Thickest Peat?)	Saturated to Seasonally Flooded	Oligotrophic	$\overline{\text{FRI}} = 2$ –3 Yrs.	Spreading Pogonia
	Spikerush – Twigrush	Spikerush Marsh		Interior Marsh	Peat	Saturated to Semi-Perm. Flooded (May be Tidal)	Oligotrophic to Mesotrophic	Fire 2° to Hydro. Natural FRI Unknown	Scarce Swamp Skipper, Elongated Lobelia
	Common Reed	Reed Marsh		Any Marsh or Sunny Wetland	Variable	Poorly Drained to Semi-Perm. Flooded (May be Tidal)	Mesotrophic to Eutrophic	Fire Will Generally Increase Stand Vigor	Least Bittern
Herbaceous Estuarine Wetland	Olney's Three – Square – Narrow Leaved Cattail	Bulrush/Cattail Marsh		Marsh	Peat	Semi-Perm. Flooded to Intermittent Exposed ("Tidal")	Mesotrophic to Eutrophic	Fire 2° to Hydro. Natural FRI Unknown	Scarce Swamp Skipper, Elongated Lobelia, Least Bittern
	Black Needlegrass	Needlerush Marsh		Marsh	Peat	Intermittent Exposed ("Tidal")	Eutrophic	Fire 2° to Hydro. Natural FRI Unknown	Least Bittern
	Big Cordgrass	Cordgrass Marsh		Outer Marsh, Near Channels	Peat	Intermittent Exposed ("Tidal")	Eutrophic	Fire 2° to Hydro. Natural FRI Unknown	Carolina Lilacopsis, Least Bittern
Woody Estuarine Wetland	Bald Cypress – Water Tupelo	Cypress/Tupelo Swamp		Near Channels	Organic-Rich Silt Loams or Peat	Semi-Perm. Flooded to Intermittent Exposed	Eutrophic	?	Epiphytic Sedge
	Coontail	Pool		In Peat Based Wetlands	Peat	Permanently Flooded	Oligotrophic to Eutrophic	Possibly Created by Peat Burn	?
	Bur Reed – Water Celery	Blackwater Creek		Upper Reaches of River and Tribs.	Organic-Rich Silt Over Sand	Permanently Flooded	Eutrophic	None	Carolina Lilacopsis
Aquatic	Hornwort – Naiad	Backbay		Lower Reaches of River and Tribs	Silt and Sand	Permanently Flooded	Eutrophic	None	Carolina Lilacopsis

Figure 6
North Landing River Ecosystem Diagrammatic Profile



many associations at different times. Key rare species that may utilize each association are also noted on Table 6. Additionally, associations which comprise rare natural communities are indicated with an asterisk (*) before their name.

Each association is described briefly below.

CORN - SOYBEAN (Zea mays - Glycine max): Most of the upland acreage in the ecosystem is occupied by row crops or other agriculture represented by this association. Corn, soybeans, and small grains are the most common crops. The common name for this association of the terrestrial class is "crops." Soils are moderately well-drained to poorly drained loams and sandy loams. The fields are fertilized, so they are generally nutrient rich. Canebrake rattlesnakes may use this association temporarily while in transit to other associations.

LOBLOLLY PINE - WHITE OAK (Pinus taeda - Quercus alba): All of the upland forest types are lumped into this one association in the terrestrial class whose common name is "pine/oak forest." Forests may be pure pine or may include varying proportions of hardwoods. In the early successional stages, tuliptree (Liriodendron tulipifera), sycamore (Platanus occidentalis), and beech (Fagus grandifolia) are common. Later seres have more oaks and hickories (Carya spp.). American holly (Ilex opaca), flowering dogwood (Cornus florida), and pawpaw (Asimina triloba) are common in the understory. If present, this association usually lies between agricultural land and the wetlands. Soils are moderately well-drained to poorly drained loams and silt loams and the nutrients are generally available at moderate levels. Intermittent wildfires as well as prescribed burning of managed forests may affect this association. Canebrake rattlesnakes and Dismal Swamp southeastern shrews reside here.

RED MAPLE - SWEETGUM - SWAMP TUPELO (Acer rubrum - Liquidambar styraciflua - Nyssa biflora): Though frequently dominated by maple, sweetgum, and tupelo, other common species of the "hardwood swamp" association of the woody palustrine wetland class include loblolly pine, green ash, and black willow (Salix nigra). Shrubs and understory trees include spicebush (Lindera benzoin), common alder (Alnus serrulata), and red bay. This association is the interior swamp, generally found between the uplands and the pocosins or marshes, but usually not close to channels of open water. Soils are organic-rich silt loams which are eutrophic to submesotrophic and temporarily to

semipermanently flooded. Fire is a factor in the hardwood swamp only during periods of drought when fires can be quite severe. Canebrake rattlesnakes, Dismal Swamp southeastern shrews, and Virginia least trillium may be found in this habitat.

***ATLANTIC WHITE CEDAR - RED MAPLE (Chamaecyparis thyoides - Acer rubrum):** The "AWC swamp" is a rare natural community of the woody palustrine wetland class. Atlantic white cedar can grow in nearly pure stands or may be mixed with other swamp species such as red maple, pond pine, or loblolly pine. AWC swamps can be found among the hardwood swamps or in the peat-based swamps on organic-rich silt loams or peat soils. Nutrient availability is generally poor and AWC swamps are saturated to seasonally flooded. Fire is a very important factor in this community type as discussed previously under natural heritage resources. In addition to possibly being utilized by canebrake rattlesnakes, Atlantic white cedar is a rare species itself.

POND PINE - RED BAY - SWEET BAY (Pinus serotina - Persea borbonia - Magnolia virginiana): In addition to the tree species which give this association its name, this association of the woody palustrine wetlands class may contain species of the hardwood swamp, such as red maple, or components of the pocosin associations, such as fetterbush. "Pond pine swamp" is the common name given this association. It is found in the interior wetlands on peat soils where it is saturated to seasonally flooded and nutrient poor. Fire is an influencing factor in this association. Atlantic white cedar and canebrake rattlesnakes can be found here.

***FETTERBUSH - RED BAY - POND PINE (Lyonia lucida - Persea borbonia - Pinus serotina):** This is the "tall pocosin" association discussed previously under natural heritage resources. The association is a member of the woody palustrine wetland class. Found in interior peat-based wetlands, tall pocosins are characteristically nutrient poor and saturated to seasonally flooded. As with the other associations in this class, fire is an influencing factor. Atlantic white cedar and canebrake rattlesnakes may be found in the tall pocosin.

***FETTERBUSH - SHEEP LAUREL - INKBERRY (Lyonia lucida - Kalmia angustifolia - Ilex glabra):** The evergreen shrubs of the "short pocosin" are tied together with a tangle of laurel-leaved greenbrier. This association is a member of the woody palustrine wetland class. Pond pines along with some Atlantic white cedar and red maple grow here, but

are few, scattered, and stunted. Another association of the interior peat-based wetlands, low pocosins are saturated to seasonally flooded and nutrient poor. Fire is important. Canebrake rattlesnakes may utilize this habitat.

WAX MYRTLE - RED MAPLE (Myrica cerifera - Acer rubrum): This is the "transitional scrub" found between the marshes and the swamps or pocosins or sometimes as "islands" in the interior of large marshes. Besides wax myrtle and red maple saplings, this association of the woody palustrine wetland class often contains poison ivy (Toxicodendron radicans), loblolly pine, swamp rose (Rosa palustris), and species of the adjacent marsh. Soils are peat or silty peat and hydrology may be tidal or variously flooded. The surface is usually very irregular and "hummocky." Canebrake rattlesnakes may utilize this habitat.

SWITCHCANE - POND PINE (Arundinaria gigantea - Pinus palustris): This association is called the "canebrake savanna." Only a small fraction of the original area covered by this association remains. While surveying the state line between North Carolina and Virginia in the 1700's, William Byrd dubbed the area the "green sea" because of the vast expanse of canebrake he found. Switchcane may grow in nearly pure stands with only scattered pond pines and other woody vegetation or may form a major or minor herbaceous component to a woodland or forest depending upon the frequency of fires burning through the area. For this reason, the canebrake savanna may fall into either the woody palustrine wetland or the herbaceous palustrine wetland classes. Canebrakes usually occur on silt loams with only a thin organic layer and may be found in poorly drained uplands or some of the higher wetlands. The canebrake rattlesnake, Dismal Swamp southeastern shrew, and Virginia least trillium may be found in this habitat.

***WALTER'S SEDGE - VIRGINIA CHAIN FERN (Carex striata - Woodwardia virginica):** The "open bog" is perhaps the rarest association in the North Landing River ecosystem and currently occurs as small, scattered openings in the pocosins. Woody species are nearly absent so the association is put in the herbaceous palustrine wetland class. An intense fire will likely enhance this association. Its rare species include the spreading pogonia and the canebrake rattlesnake; Walter's sedge is also a rare plant found only in this association. The open bog is the most nutrient poor of all the peat-based interior wetlands. The association is generally found in the interior of pocosins. Its deep saturated peat may be domed and completely rain-fed. In the long term, it is likely that peat

accumulation and nutrient regime maintain this association, but fires may reduce the stature of woody species enough to open areas of short pocosin into bogs.

***SPIKERUSH - TWIGRUSH (Eleocharis spp. - Cladium mariscoides):** Composition of this rarest of the marsh associations was discussed in the natural heritage resources section. Termed "spikerush marsh" for convenience, this association is dominated by a wide variety of sedge and rush species which almost always includes one or more spikerushes. Species richness is very high and rare species, such as the elongated lobelia and scarce swamp skipper, are often found here. Spikerush marshes are found in the interior of marshes, away from the creeks and guts. Because of this location and possibly to peat doming, spikerush marshes may not be subject to as great a tidal amplitude as the outer marsh types and, in some cases, may be influenced more by ground-water seepage or rain-fall than tidal action (thus its placement in both the estuarine and palustrine herbaceous wetland classes). This association also has the lowest salinities of the marsh types. Soils of spongy peat are deep and nutrient availability is low. Fires may not be important natural factors, but can be used as an effective management tool.

COMMON REED (Phragmites australis): This potentially invasive grass may form pure stands in any marsh or other sunny wetland except that the plant does not usually grow in habitats subject to deep, prolonged inundation. The common name for the association is "reed marsh." The species is quite adaptable; soil, nutrient, and hydrologic tolerance limits are wide. Its adaptability allows it to fall into either the herbaceous palustrine wetland or herbaceous estuarine wetland class. Least bitterns may utilize this association for cover. Except for burns in the early growing season, fires will increase stem density and stand vigor.

***OLNEY THREE-SQUARE - NARROW-LEAVED CATTAIL (Scirpus americanus - Typha angustifolia):** The "bulrush/cattail marsh" is a marginally rare marsh type found mostly in interior marsh areas. This association is in the herbaceous estuarine wetland class. Composition can be quite variable; some other common species include swamp rose mallow (Hibiscus moscheutos), seaside mallow (Kosteletzkya virginica), arrow arum, common reed, pickerelweed, duck potato, big cordgrass, broad-leaved cattail (Typha latifolia), southern cattail, saltmeadow hay (Spartina patens), switchgrass, spikerushes, saw grass, camphorweed, smartweeds, rushes (Juncus spp.), and other bulrushes. This association has more tidal influence and, thus more nutrients and slightly higher

salinity, than the spikerush marsh. The natural role of fire in this association is not determined, but the hydrologic and nutrient regimes are likely more influential than the fire regime. This association may contain sawgrass, however, which is a fire-adapted species. The scarce swamp skipper, elongated lobelia, and least bittern may be found in this association.

BLACK NEEDLERUSH (Juncus roemerianus): The "needlerush marsh" often occurs in pure stands and usually is found in the outer marshes. When other species do occur in this association, they often include the species listed in the bulrush/cattail marsh. This marsh type of the herbaceous estuarine wetland class is typically eutrophic, tidal, and slightly to moderately brackish. The natural role of fire in this association is not determined, but the hydrologic and nutrient regimes are likely more influential than the fire regime. This association often contains sawgrass, however, which is a fire-adapted species. Least bitterns may utilize this habitat.

***BIG CORDGRASS (Spartina cynosuroides):** "Cordgrass marshes" also often occur in pure stands and cover large areas of the preserve's marshes, especially along the creeks and guts. Other species may include any number of those listed with the bulrush/cattail marsh. This association of the herbaceous estuarine wetland class is eutrophic, tidal, and slightly to moderately brackish. The natural role of fire in this association is not determined, but the hydrologic and nutrient regimes are likely more influential than the fire regime. Least bitterns may utilize the habitat and Carolina lilaeopsis grows at the edge of this association in shallow water and mud flats.

***BALD CYPRESS - WATER TUPELO (Taxodium distichum - Nyssa aquatica):** Few tree species other than bald cypress and water tupelo are able to tolerate the essentially aquatic conditions of this association leading to its common name, "cypress/tupelo swamp," and its placement into its own class, woody estuarine wetland. This association is most common in the upper reaches of the North Landing River and its tributaries where it lines the guts, creeks, and river. Water levels are affected by wind tides, but salinity is generally quite low. Epiphytic sedge may be found growing on cypress knees or flared water tupelo trunks in this association.

COONTAIL (Ceratophyllum): The "pool" or shallow pond is an association of the aquatic class. When oxidation of peat in the marsh or

peat-based swamps occurs either from fire or decomposition, depressions in the surface may form which are below the water table resulting in standing water. Flooding eliminates the wetland species in favor of aquatics, such as coontail. Emergents may cling to the pool's edges. Extreme upper reaches of guts may mimic this environment and may also be abundant with coontail and other aquatics. Key rare species utilization is undetermined.

BUR REED - WATER CELERY (Sparganium americanum - Vallisneria americana): The open water aquatic environments have been divided into two associations. The upper reaches of the river and its tributaries may have submerged aquatic plants such as bur reed and water celery or vegetation may be absent. This is the "blackwater creek" association. These channels are normally lined by swamps, rather than marshes, and the water appears black from the tanins that come from the swamps. Though still subject to tides, salinity is very low. Carolina lilaeopsis may be found in the shallow waters or mud flats at the edge of marshes in this association.

HORNWORT - NAIAD (Ceratophyllum demersum - Najas guadalupensis): The lower reaches of the river and its major tributaries are "backbay" communities. Submerged aquatics such as hornworts or naiads may grow in these waters. Large areas of open water, expansive bordering marshes, tides, and fresh to slightly brackish conditions characterize this association. There are large areas of transition between the backbay and blackwater creek associations that have many characteristics of both associations. Carolina lilaeopsis may be found in the shallow waters or mud flats at the edge of marshes in this association.

FUNCTION OF THE ECOSYSTEM

The classes and association help to define the ecosystem's structure. Ecosystem function is driven by influencing factors such as natural ecological processes and gradients and anthropogenic disturbances and alterations. Influencing factors of the North Landing River ecosystem are grouped into six categories which are discussed briefly below.

SUBSTRATE: This category covers conditions, cycles, and processes affecting the physical characteristics of all the substrates of the ecosystem. Existing substrate conditions such as peat depth and composition, soil type, and elevation are included. Many cycles and processes pertaining to substrate gain, loss, or change in physical

character are also relevant. These influencing factors may include erosion (of peat or soil), sedimentation, primary production (peat accumulation), storms and floods (leading to erosion or sedimentation), dredging, dredge spoil disposal, channel migration (consisting of simultaneous erosion and sedimentation), and peat oxidation (as by decomposition or fire). The ultimate effect of these influencing factors is change or maintenance of substrate composition and structure.

NUTRIENTS: This category includes nutrient conditions, cycles, and processes in the water and soil. Phosphorus or nitrogen are usually the limiting nutrients of a system, but sulfur, potassium, carbon, and trace elements also can be important. Nutrient cycling/regime, eutrophication (as from pollution), nutrient availability, nutrient release (as from decomposition or fire), and nutrient uptake are all relevant factors. The ultimate effect of these influencing factors is the maintenance of or a change in the nutrients in the ecosystem.

HYDROLOGY: Hydrologic factors include wind tides, sea level change, ditching/drainage, impoundment, water withdrawal/discharge, infiltration, runoff, evapotranspiration, flooding, ground-water recharge/discharge, surface-water flow, ground-water flow, water table level and fluctuations, and precipitation. All contribute to the dynamics of the hydrology of the ecosystem.

FIRE: The fire category includes such aspects as ground versus surface versus crown fires, fire severity, fire intensity, fire return interval, and lack of fire. Fire may lead to the maintenance, renewal, or total change of a given association.

SPECIES INTERACTIONS: This category includes biological succession, interspecific competition, aggressive plant invasion, herbivory, direct human disturbances to the system (trampling, road construction, etc.), disease, predation, seed banks, and rodent eat-outs and trails. All relate to the effects of one species, population, or association on another.

CHEMICAL: This category involves chemical factors of the soil, air, and water not covered under nutrients or any of the other categories. It includes soil oxygen content, natural soil and water Ph, BOD, acid deposition, salinity, and spills, leaks, or other unnatural introductions of pesticides, petroleum, metals, or other toxics.

MAJOR INFLUENCING FACTORS

Six influencing factors from the above categories have been selected for inclusion in the conceptual ecological model. These six influencing factors were chosen because they meet one or both of two criteria: (1) the influencing factor accounts for a large proportion of the function of the ecosystem and (2) land managers may be able to exert at least some control over the influencing factor. The six influencing factors are represented as two gradients and four processes. The gradients are nutrient regime and hydrologic regime and the processes are fire, succession, eutrophication, and salinity increase. Each is discussed below.

NUTRIENT REGIME: One of the most influential factors affecting the natural community composition is availability of nutrients. Nutrient availability is represented as a gradient in the model. The terms that are used to indicate relative nutrient availability are (in order of increasing availability) oligotrophic, submesotrophic, mesotrophic, permesotrophic, and eutrophic. In the peat-based wetlands, nutrient levels are closely related to peat depth. As peat accumulates in the interior wetlands (i.e., away from the surface channels), less water enters the association from ground-water seepage or surface-water run-off sources and the system moves towards being entirely rain-fed. This leads to increasingly poor nutrient conditions. Land managers may have a limited amount of control over the nutrient regime of the ecosystem, mostly through the prevention of anthropogenic eutrophication which is further discussed below.

HYDROLOGIC REGIME: As a riverine ecosystem, the hydrologic regime is certainly one of the most important influencing factors in the North Landing River ecosystem. Generally, the average water table gradually rises relative to the ground surface from the uplands to the river. Hydrologic regime is, therefore, represented as a gradient. Increasing relative hydroperiod of aquatic and wetland associations is represented by the following terms: saturated, temporarily flooded, seasonally flooded, semi-permanently flooded, intermittently exposed, and permanently flooded. Upland hydrology is referred to simply as well-drained or poorly-drained. The hydrology of the North Landing River ecosystem is unlike that of most estuarine ecosystems. Regular significant lunar tidal action is negligible (Doumlele 1976). What is generally referred to as tidal action in the North Landing River system is more accurately described as irregular, wind-driven water-level

fluctuations. The word "tide" is considerably more concise and convenient, however. Because winds must blow from a certain direction, at a certain minimum velocity, for a certain minimum period of time to cause a significant water-level change, tidal events, either lows or highs, are irregular and infrequent. Most of the time, the water level does not change significantly from the mean water level. However, when significant water-level fluctuations do occur, they usually last longer than lunar tidal events. Additionally, extreme water-level fluctuations are not uncommon and may have far reaching implications, completely draining marshes or completely inundating higher inland wetlands for several days at a time. The wind tides of the North Landing River system are a very important component of the hydrologic regime. Wind tides could be separated out from the hydrology gradient and addressed as a process in future iterations of the model. Land managers have a variable amount of control over the ecosystem's hydrology. Although land managers cannot control wind-tides or rainfall, they can help to minimize disruption of natural hydrologic processes. Maintaining locks, discouraging new canals, determining the most compatible maintenance dredging and disposal techniques, preventing draining of sensitive habitats, and installing water-level control structures in existing ditches are examples.

FIRE: Many of the palustrine associations are fire adapted or fire dependent communities. Fire can also be used as an effective management tool for several of the estuarine associations. Fire could be represented as another gradient expressed in terms of mean fire return interval. Representation of a third dimension on a two dimensional diagram is difficult, however, and fire expressed as a mean fire return interval gradient would not allow representation of fire intensity. For these reasons, fire is represented as a process. Land managers can have a significant amount of control over this process, both by suppressing (or not suppressing) wildfires and by conducting prescribed burns.

SUCCESSION: Biological succession is the replacement of one community of organisms by another in an orderly and predictable manner. Succession is an important influencing factor from the species interaction category. Certain associations are linked by ecological successions as stages or "seres" in a typical progression of one association to another. Time is a major driving force behind succession. In many ways, succession works opposite to fire in the ecosystem. During periods between fires, succession occurs in many associations. The passage of a fire may "set back" the sere of an association by

reducing the amount of biomass, especially that of woody species. Succession is represented as a process in the model. Prescribed burning and other ecological management tools can be utilized by land managers to decelerate or remove the effects of ecological succession in some situations.

EUTROPHICATION: Represented as a process, this influencing factor involves the anthropogenic introduction of nutrients into the ecosystem. Water is often the carrier of nutrients; nutrients are generally added to associations via surface-water or ground-water flows or in the sediments carried by the water. Fires can result in short term eutrophication, creating a "spike" in nutrient availability through oxidation of biomass. Land managers can exert some control over eutrophication by influencing surrounding land management practices.

SALINITY INCREASE: Under natural conditions, the North Landing River is a freshwater to slightly brackish water system except for periodic intrusion of brackish waters into the lower reaches caused by wind-driven water-level fluctuations. In fact, Doumlele (1976) found only very low salinities (less than 1 ppt) during the marsh survey of the North Landing River. Doumlele hypothesized that the brackish water species growing in the system, such as big cordgrass and black needlerush, are relict populations from a period when the North Landing River's waters were more saline. The canals connecting the North Landing River system to the saltier waters of the Chesapeake Bay have caused some concern regarding increased influx of salty water, especially in the West Neck Creek area where a connection to more saline waters has been established with the completion of the bypass canal around Canal Number Two. Because of this concern, salinity increase is represented as a process. Land managers might be able to effect some control over salinity by influencing water use.

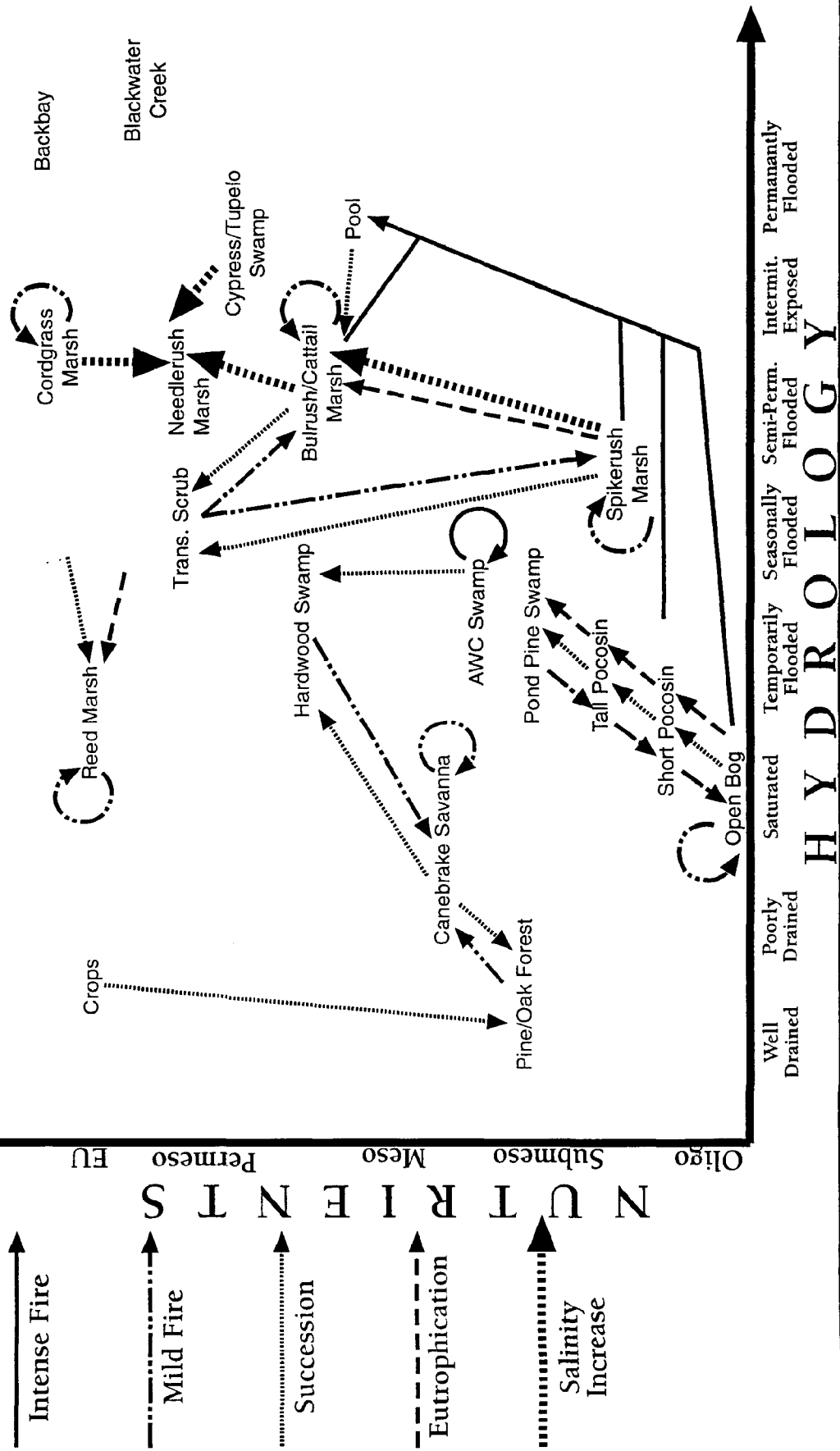
INTEGRATION OF STRUCTURAL AND FUNCTIONAL COMPONENTS

The associations and influencing factors of the ecosystem can be graphically integrated into a conceptual illustration of the structure and function of the North Landing River ecosystem. This conceptual ecological model is depicted in Figure 7. The model is most easily understood when considered in steps or pieces.

First, the two gradients, hydrology and nutrients, are assigned to the horizontal and vertical axes, respectively. Nutrient availability increases

Figure 7

North Landing River Ecosystem Conceptual Ecological Model



up the vertical axis; relative average water-table level increases across the right of the horizontal axis.

Based on this system of coordinates generated by the two gradient axes, each association can be ordinated or "plotted" in the illustration based on its nutrient and hydrologic tolerances. Some assumptions have to be made and future revisions of the model may depict different relative positions of each association. Also, several artistic liberties are taken. For those associations which occur across a broad range of nutrient and hydrological conditions, the association name is written as much in the middle of those tolerances as the diagram will allow. Similarly, some associations are spread apart a little more than they should be to avoid crowding in the diagram.

With the associations and gradients depicted, the ecological processes can be added. Processes are represented as arrows leading from one association to another. In order to prevent the diagram from becoming over-complicated, a few liberties are also taken with the process arrows. Only those processes which are considered of major significance in the ecosystem or which have a direct bearing on management planning are shown. Several consequences of fire, succession, or the other processes that are less important ecologically or less pertinent to ecological management are not shown. Several processes can "skip" associations, that is, a process that drives a progression of associations can in some instances bypass one or more of the intermediate steps. This skipping phenomenon is not shown, but the step-wise progressions are depicted. The succession and eutrophication arrows leading to the reed marsh appear to originate from nowhere. Actually, the reed marsh can be derived from so many associations via succession or eutrophication (depending on the presence of gemmules) that these arrows are all but omitted to help keep the diagram legible.

The model will assist ecological managers in determining management actions and to help set measures of success. For example, if the ecological goal is to create and maintain an open bog association, an ecological manager can examine the model and determine that to accomplish that objective the hydrology must be maintained, the area must be protected from eutrophication, and the bog must be subject to periodic burns or the association will succeed into a short pocosin. Because the model is conceptual, however, it cannot tell the ecological manager when to burn, how often to burn, or how much phosphorus is too much. The model will evolve as more information becomes available.

STRESS ASSESSMENT

An assessment of stresses facing a site is an important element of any conservation plan, for conservation actions meant to attenuate stresses cannot be planned and implemented successfully if the stresses are not clearly identified. The conservation planning report discusses the stresses to each natural area and its natural heritage resources. A brief discussion of general stresses on the North Landing River ecosystem is presented below. Stresses are considered in approximate order of decreasing threat. Table 7 lists each stress, the impacts of the stress, and the source(s) of the stress. Also included is an indication of the presence (current or potential) and degree (low, moderate, high) of the stress. For current stresses, degree refers to the level of threat to the ecosystem or its natural heritage resources. If the stress is listed as potential, degree refers to the supposed probability of that stress occurring.

Although stresses are discussed separately, it is important to note that often more than one stress is acting on a community or population at once. Many of the stresses act simultaneously, cumulatively, or even synergistically to aggravate problems afflicting the ecosystem.

FIRE DEFICIT

The decrease in the frequency of fires in the ecosystem over the past several decades is probably the most immediate threat to many of the natural heritage resources. Certain species and natural communities are adapted to or even dependent upon fire to maintain their habitat or complete their life cycle. Examples include open bogs, short pocosins, tall pocosins, AWC swamps, pond pine, Atlantic white cedar, Walter's sedge, and spreading pogonia. Many other species, such as large cranberry, may return after the re-introduction of fire. Fire can also be used as an ecological management tool for other habitats. For example, carefully applied prescribed fire can help halt the succession of the rare spikerush marsh into transitional scrub. Fragmentation of the landscape, and to a lesser degree, active fire suppression, has led to this stress.

ALTERED SURFACE-WATER QUANTITY

If predictions by meteorologists and ecologists regarding accelerated sea-level rise are correct, sea level will likely rise faster than the associations can adapt or migrate to accommodate the change. Local extirpation of

TABLE 7
STRESS ASSESSMENT FOR
NORTH LANDING RIVER ECOSYSTEM

STRESS:IMPACT	PRESENCE:DEGREE	SOURCE
fire deficit: loss of fire dependent communities and species	current:high	fragmented landscape, fire suppression
altered surface-water quantity: reduction or loss of certain habitats/communities	potential:high	accelerated sea-level rise, filling/draining wetlands, subsidence, ditching/dredging, channelizing, impoundment, increased impervious surface area (inc. run-off)
altered surface-water quality: alteration or reduction of certain habitats/communities	current:medium	point and non-point source pollution including nutrients, sediments, toxics (petroleum, pesticides, metals, etc.); salt water intrusion
altered ground-water quantity or quality: alteration of ground-water dependent/influenced habitats/communities	current:medium	leaching of fertilizer, pesticides; spills/leaks of toxics, large-scale ground-water withdrawal; increased impervious surface area, many others...
problem species: displacement of rare species; alteration or loss of sensitive habitats and rare natural communities	current:medium	common reed, nutria, deer, predators
take: elimination of individuals, reduced population vigor	current:medium (to certain species)	intentional killing, road kills, trampling, collecting
disturbance: interference with foraging, resting, reproduction or certain animals	current:low	motorboats, etc., nature-based tourism, other recreation; logging; construction
direct habitat conversion: reduction or loss of habitats/communities	potential:low	clearing forests, draining/filling wetlands, development, etc.

natural heritage resources which comprise or occur in these threatened associations is possible. Other possible sources of altered surface-water quantity include filling draining, impoundment, dredging, channelization, and increased run-off from increased impervious surface area. Any disruption of natural surface-water flow patterns or river channel migration would fall under this category.

ALTERED SURFACE-WATER QUALITY

Water quality problems are a current and moderate stress on the system. Degraded water quality may lead to reduction or loss of habitats and communities and the rare species they support. Point and nonpoint source pollution are the origins of water quality problems. Contaminants may include nutrients, sediments, toxics (petroleum, pesticides, metals, etc.), and salt. These contaminants either directly affect the ecosystem or lead to other problems, such as reduced dissolved oxygen levels or reduced light penetration.

ALTERED GROUND-WATER QUANTITY OR QUALITY

Little is known about the ground-water regime of the North Landing River ecosystem and precise predictions as to the effects of ground-water quality or quantity alteration are difficult to assess. Alteration of ground-water influenced or dependent communities and habitats is a possible problem. Sources of this stress may include leaching of fertilizers and pesticides into the ground water from agricultural fields, spills or leaks of toxic compounds, large-scale ground-water withdrawal, increased impervious surface area, landfills, abandoned wells, salt-water intrusion, ground-water injection, and septic systems.

PROBLEM SPECIES

The main problem species of concern in the North Landing River ecosystem are common reed, nutria, and white-tailed deer (*Odocoileus virginiana*). Intermediate predators, such as opossums (*Didelphis virginiana*), striped skunks (*Mephitis mephitis*), and raccoons (*Procyon lotor*), and other invasive plants could also become threats to some species and habitats. Problem species may cause the displacement of rare species or may cause the reduction or loss of rare natural communities or significant habitats upon which some rare species depend. Problem species are a moderate, current threat to the

ecosystem.

TAKE

"Take" refers to the direct killing or other effective removal from the population of individuals by humans. This is a moderate, current threat to some rare species. Take may be in the form of intentional killing, road kills, trampling, and collecting (plants or animals). The canebrake rattlesnake is an example of a rare species threatened by take.

DISTURBANCE

Certain animal species, for example, great blue herons (Ardea herodias), are sensitive to disturbance from human activities. The disturbance may interfere with foraging, resting, or reproductive behavior and could eventually lead to abandonment of an area. Motorboats (including personal watercraft and waterskiing), nature-based tourism, and other recreational pursuits can be the culprits. This is a current, but low-level, stress to the system. The degree of this stress could increase if recreational activities in the area increase without careful planning.

DIRECT HABITAT CONVERSION

Clearing of forests, draining or filling of marshes, development, and other factors can directly eliminate significant habitats or rare natural communities. Reductions in the amount of suitable habitat bring about reductions in the populations of rare species. Fortunately, the potential for this threat is generally low because much of the significant habitats of the ecosystem are already protected. There are exceptions to this generalization, however, leading to the inclusion of this stress on the list.

CONSERVATION PLANNING BOUNDARIES

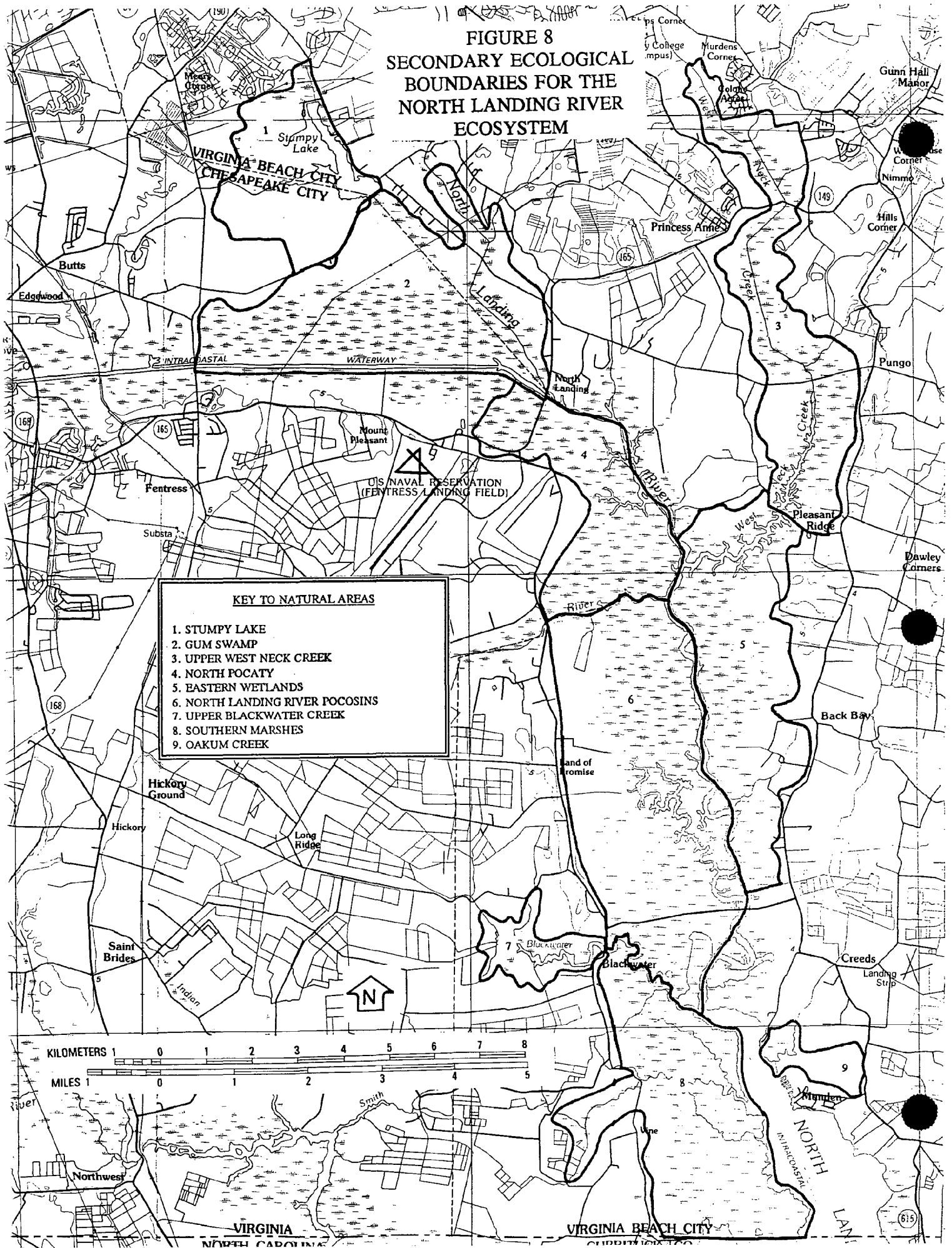
Conservation planning boundaries are the key component of any site conservation plan. They help to guide conservation efforts of a natural area by delineating areas of ecological significance and addressing the stresses and ecological needs of the site. Traditionally, primary ecological boundaries and secondary ecological boundaries are used in site conservation plans. Primary ecological boundaries encompass all natural heritage resources of a natural area, including the habitat of rare species and the extent of rare or exemplary natural communities. Secondary ecological boundaries encompass all lands and waters

intended to mitigate natural and human stresses to the natural heritage resources of the site, that is they generally delineate buffer areas. For example, secondary ecological boundaries may encompass areas intended to protect water quality, screen human activity from animals sensitive to disturbance, or provide migration corridors between two or more areas of rare species habitat.

Conservation planning boundaries should not be interpreted as regulatory zones or acquisition boundaries, but as conservation tools to help guide the protection and stewardship of the natural area.

Detailed information on the conservation planning boundaries for the North Landing River ecosystem, including maps of the primary and secondary ecological boundaries, can be found in the conservation planning report. Figure 8 shows the extent of the secondary ecological boundaries for all nine natural areas in the North Landing River ecosystem.

**FIGURE 8
SECONDARY ECOLOGICAL
BOUNDARIES FOR THE
NORTH LANDING RIVER
ECOSYSTEM**



MANAGEMENT

PRIMARY LAND CLASSIFICATION

According to the State Lands Resource Management Plan Guide (vdcr 1991) developed by the VDCR Lands Classification Committee, a site should be classified according to the format described in the departmental land classification system. The types of land classifications recognized by VDCR are as follows:

State Park,
State Natural Area Preserve,
State Cultural Resource Area,
State Reserve,
State Trail/Greenway, and
Special Interest Area.

In accordance with the land classification system, North Landing River Natural Area Preserve's primary land classification is **State Natural Area Preserve**.

The State Natural Area Preserve classification is defined as a "land or water area of variable acreage that may offer low intensity public use." "The primary purpose of the property is to support rare plant and/or animal species and/or unique natural communities, and it is, therefore, dedicated to ensure their preservation." (VDCR 1991)

ZONE CLASSIFICATION

According to the State Lands Resource Management Plan Guide, there are three major zones under each of the six primary classifications which may be applied to a property. The zones, based on resource analyses, will direct the type of use which may occur on land areas under a major classification. The zones recognized by the VDCR Lands Classification Committee are as follows:

Non-sensitive,
Sensitive, and
Preservation.

The Preservation zone is further divided into three sub-types:

Preservation - Natural,
Preservation - Cultural, and
Preservation - Special.

In accordance with the land classification system, North Landing River Natural Area Preserve's zone classification is **Preservation - Natural**. Note that all of the preserve is zoned Preservation - Natural.

Preservation Zone - Natural is defined as "actual or proposed natural area preserves dedicated to protecting natural heritage resources managed for the habitat of threatened or endangered species or natural communities present on the property."

REGULATIONS, POLICIES, AND GUIDELINES

Regulations pertaining to the use and management of state-owned natural area preserves are currently under development by VDCR. Once use regulations have been established and codified, VDCR will also develop departmental policies and guidelines for management of properties within the state natural area preserve system.

According to the State Lands Resource Management Plan Guide, guidelines should address the following topics:

- recreation/other public uses,
- hunting, fishing, trapping,
- agriculture,
- timber,
- water,
- minerals and geology,
- soils,
- roads, utilities, access,
- facilities,
- natural heritage resources,
- wildfire,
- insects and disease, and
- active management of vegetation and wildlife.

TNC has developed policies for management of their preserves which are currently under review for updating and revision.

Policies, regulations, and guidelines will be applied to tracts respective

of ownership. It is expected that the VDCR policies and guidelines and the TNC policies for management will closely parallel each other in content and will not cause conflicts or other problems in the management of the preserve as a single unit.

MANAGEMENT DIRECTION

GOALS AND OBJECTIVES

This section contains the most important component of the management plan: goals and objectives. The section is organized hierarchically. **Categories** are the highest level. Categories identify the general topic covered by a set of goals and objectives. A brief discussion of each category is provided. **Goals** are the second level. A goal is a general result towards which management effort is directed. The lowest level are the **objectives**. Objectives are more specific aims, usually with a measurable end result, designed to help realize the goal. Objectives are the most basic and operational level of the management direction. As such, they are used as the basis for development of management synopses.

■ **CATEGORY: Inventory and Research**

There are several areas of need for biodiversity inventory and scientific research at the North Landing River Natural Area Preserve and vicinity. The additional information and knowledge regarding the preserve and its ecosystem will be used to guide ecological management. Biological monitoring is not included under this category, but under stewardship.

- **GOAL 1: Conduct additional biodiversity inventory.**
 - **OBJECTIVE 1A:** Complete additional inventory for rare plants.
 - **OBJECTIVE 1B:** Complete additional inventory for rare animals.
- **GOAL 2: Conduct scientific research and assessment of ecosystem structure and function.**
 - **OBJECTIVE 2A:** Continue hydrologic, geochemical, and vegetation research.
 - **OBJECTIVE 2B:** Continue fire and vegetation history research.
 - **OBJECTIVE 2C:** Document and map vegetation types.
- **GOAL 3: Conduct research on priority ecological management techniques.**
 - **OBJECTIVE 3A:** Research effectiveness of prescribed fire in the control of common reed.
 - **OBJECTIVE 3B:** Research effectiveness of fire in regenerating Atlantic white cedar.
 - **OBJECTIVE 3C:** Research effects of fire on pocosin and canebrake communities.
 - **OBJECTIVE 3D:** Research effects of fire on marsh communities.
- **GOAL 4: Conduct research on priority water quality issues.**
 - **OBJECTIVE 4A:** Evaluate effects of maintenance dredging of ICW.
 - **OBJECTIVE 4B:** Determine extent and effects of salinity changes associated with bypass canal.

■ **CATEGORY: Information Management and Planning**

This category includes all goals and objectives related to management of biodiversity data in BCD, environmental review, and continued management planning. Specific reporting and planning needs are addressed under their respective goals.

- **GOAL 5: Maintain and utilize current records in BCD.**
 - **OBJECTIVE 5A:** Annually review and revise as necessary EOR's, SBR's, and TBR's.
 - **OBJECTIVE 5B:** Enter and annually update Stewardship Actions.
 - **OBJECTIVE 5C:** Produce an SSS annually.
- **GOAL 6: Provide appropriate environmental review services.**
 - **OBJECTIVE 6A:** Provide appropriate environmental review of projects proposed in the vicinity of the preserve.
- **GOAL 7: Continue to develop resource management plan.**
 - **OBJECTIVE 7A:** Periodically review resource management plan and revise as necessary.
 - **OBJECTIVE 7B:** Continue to refine the site conservation plan.
 - **OBJECTIVE 7C:** Continue to refine the conceptual ecological model.
 - **OBJECTIVE 7D:** Develop a fire management plan.

■ CATEGORY: Protection

Although most of the natural heritage resources of the ecosystem have been protected through acquisition, the preserve is not isolated from the surrounding land use. Preservation of the natural heritage resources is not assured just by owning their habitat. Additionally, acquisition of several tracts has not been completed as of this writing and many tracts yet remain to be dedicated. Efforts to more adequately protect the natural heritage resources of the North Landing River ecosystem should continue.

- **GOAL 8: Complete protection projects currently in progress.**
 - **OBJECTIVE 8A: Complete acquisition of targeted tracts.**
 - **OBJECTIVE 8B: Complete dedication of all tracts owned by TNC and VDCR.**
- **GOAL 9: Continue to employ a variety of protection tools to secure the viability of the natural heritage resources.**
 - **OBJECTIVE 9A: Secure management agreements or natural area registry on priority upland tracts.**

■ **CATEGORY: Stewardship**

Stewardship is the long term management of land and water to maintain and enhance its natural and cultural resources. The stewardship category comprises the bulk of the goals and objectives for the preserve.

- **GOAL 10: Provide appropriate biological monitoring.**
 - **OBJECTIVE 10A: Conduct biological monitoring of selected rare species, problem species, and natural communities.**
- **GOAL 11: Provide appropriate ecological management.**
 - **OBJECTIVE 11A: Complete common reed demonstration project.**
 - **OBJECTIVE 11B: Reintroduce fire into the pocosins.**
 - **OBJECTIVE 11C: Utilize fire as a marsh management tool.**
 - **OBJECTIVE 11D: Develop and implement a problem species assessment and control plan.**
- **GOAL 12: Appropriately manage hunting on the preserve.**
 - **OBJECTIVE 12A: Continue to manage duck hunting adjacent to the preserve in cooperation with VDGIF.**
 - **OBJECTIVE 12B: Develop and implement a deer hunting plan and guidelines.**
- **GOAL 13: Design and implement programs to restore and maintain water quality and quantity.**
 - **OBJECTIVE 13A: Develop a model land-use plan for priority upland tracts.**
 - **OBJECTIVE 13B: Design and implement a demonstration water quality conservation project.**

■ **CATEGORY: Stewardship (continued)**

- **GOAL 14: Provide appropriate public access and recreational opportunities.**
 - **OBJECTIVE 14A: Complete development of public access facilities at Kellam tract.**
 - **OBJECTIVE 14B: Develop and implement public access and recreation strategies.**
- **GOAL 15: Provide appropriate preservation of scenic resources.**
 - **OBJECTIVE 15A: Review proposed projects for potential impacts to scenic resources.**
 - **OBJECTIVE 15B: Encourage a regional approach to scenic resources management.**
- **GOAL 16: Provide appropriate preservation of historic resources.**
 - **OBJECTIVE 16A: Review proposed projects for potential impacts to historic resources.**
- **GOAL 17: Provide appropriate site management.**
 - **OBJECTIVE 17A: Establish and maintain appropriate signage.**
 - **OBJECTIVE 17B: Implement effective site security.**
 - **OBJECTIVE 17C: Maintain access facilities and other amenities.**
- **GOAL 18: Provide appropriate interpretation, education, and promotion.**
 - **OBJECTIVE 18A: Develop and distribute written educational materials.**
 - **OBJECTIVE 18B: Provide educational programs.**
 - **OBJECTIVE 18C: Appropriately promote the preserve.**

■ **CATEGORY: Cooperative Management**

Cooperative management of the North Landing River Natural Area Preserve is crucial to the successful preservation of its natural heritage resources. In addition to the cooperative management process within VDCR, management partners outside the agency must also be involved.

- **GOAL 19: Coordinate management with existing partners.**
 - **OBJECTIVE 19A: Coordinate management between VDCR and TNC.**
 - **OBJECTIVE 19B: Coordinate management with other existing partners.**
- **GOAL 20: Develop new management partners and cooperative management strategies.**
 - **OBJECTIVE 20A: Establish a Stewardship Advisory Committee.**
 - **OBJECTIVE 20B: Enlist support of private landowners and community organizations.**

MANAGEMENT SYNOPSES

Management synopses are short plans recommending why, when, and how an objective may be accomplished and suggesting who may be responsible for its implementation. A management synopsis for each objective appears on the following pages. Each synopsis follows a standard format explained below. Where an action plan is called for in a synopsis, the words "ACTION PLAN" appear parenthetically. Action plans are explained in a following section.

◆ **OBJECTIVE:** This heading contains a reiteration of the objective.

DETAILED OBJECTIVE: A more detailed version of the objective, often containing additional information, is provided.

JUSTIFICATION: A discussion of need for the objective is furnished.

TASKS: A summary of suggested tasks or steps towards accomplishing the objective are listed.

SCHEDULE: A time-line for implementing the objective is recommended.

PERSONNEL: Primary responsibility of accomplishing the objective is suggested (indicated by the symbol "1°"). Normally, a single person, identified by job title, is given the responsibility of accomplishing an objective. This suggestion is not meant to preclude delegation or joint efforts. Personnel to assist with implementation also are recommended (indicated by the symbol "2°"). Currently unfilled positions are indicated by an asterisk (*).

DELIVERABLE: Possible outcomes, products, or other measures of success for the objective are described.

PRIORITY: The relative priority of the objective, low, medium, or high, is indicated. Priority indicates importance on a relative scale, that is, objectives with a low priority are not unimportant, just less critical than other objectives. Normally, objectives which pertain directly to the preservation of natural heritage resources receive a high priority, objectives which pertain indirectly to natural heritage resource preservation receive a medium priority, and objectives which do not pertain to natural heritage resource preservation receive a low priority.

◆ OBJECTIVE 1A: Complete additional inventory for rare plants.

DETAILED OBJECTIVE: Conduct additional inventory for Virginia least trillium in the forested swamps and for historically documented rare plants, such as large cranberry, in burned areas.

JUSTIFICATION: Much potential habitat for Virginia least trillium exists which has not been surveyed at the appropriate time of year to detect the plant; need to determine full extent of occurrences of this globally rare taxon to be able to manage for the plant. Rare plants historically documented from the area, but apparently no longer present, may return to certain habitats following the passage of fire. These habitats need post-burn checks for rare plants. Need this inventory data to help guide and measure success of ecological management.

TASKS: Plan several site visits during appropriate periods (Mar. and Apr. for trillium, several weeks to several years post-burn for others), conduct surveys, submit field notes and EOR's.

SCHEDULE: Depends on incidence of fire for post-burn work. For trillium - conduct surveys in Mar. or Apr. '95.

PERSONNEL: 1° - DNH Botanist. 2° - DNH Regional Steward*, TNC Steward.

DELIVERABLE: EOR's and/or negative search data.

PRIORITY: medium

◆ **OBJECTIVE 1B:** Complete additional inventory for rare animals.

DETAILED OBJECTIVE: Conduct additional biological inventory on preserve and in vicinity for a number of crustaceans, lepidopterans, odonates, amphibians, reptiles, mammals, and birds.

JUSTIFICATION: Animal species are not as well inventoried as plants and communities. Need to determine complete list of natural heritage resources which utilize the site and vicinity and where they are found to determine if active ecological management or alterations in visitation patterns are necessary to preserve and enhance these occurrences.

TASKS: Plan several site visits during appropriate dates; conduct surveys; submit EOR's and field notes.

SCHEDULE: Plan surveys by 3/95; conduct surveys 4/95-11/96, submit field notes and EOR's by 3/96.

PERSONNEL: 1° - DNH Zoologist. 2° - DNH Regional Steward*.

DELIVERABLE: EOR's and/or negative search data.

PRIORITY: medium

◆ **OBJECTIVE 2A:** Continue hydrologic, geochemical, and vegetation research.

DETAILED OBJECTIVE: Continue ground-water monitoring and analysis and associated geochemical and vegetation monitoring in the North Landing River wetlands.

JUSTIFICATION: Need to establish some level of basic knowledge of the ground-water regime, what associations are affected by ground water, and how they may be affected to be able to assess stress to the system from ground-water threats and guide ameliorative management, if deemed necessary.

TASKS: Continue monitoring pilot transect according to project proposal (ACTION PLAN), seek additional funding for two additional transects, implement according to proposal (ACTION PLAN).

SCHEDULE: Monitoring of existing transect at some level of detail will be continuous, reports due quarterly and annually, proposals for additional funding submitted 12/94.

PERSONNEL: 1° - DNH Stewardship Director. 2° - USGS Hydrologist, DNH Regional Steward*, TNC Stewardship Director.

DELIVERABLE: Annual and final reports, increased understanding of ground-water regime.

PRIORITY: high

◆ **OBJECTIVE 2B:** Continue fire and vegetation history research.

DETAILED OBJECTIVE: Analyze peat cores already taken from preserve to establish past fire regime and plant community composition; take and analyze additional cores.

JUSTIFICATION: Need to understand historical fire regime and plant communities to help guide fire management actions in pocosin and other fire dependent areas.

TASKS: Continue sampling and analysis of cores according to project proposal (ACTION PLAN).

SCHEDULE: Study already designed and set-up; initial sampling to continue through 4/95, analysis and final report due-dates undetermined.

PERSONNEL: 1° - DNH Stewardship Coordinator. 2° - Fire Ecology Specialist, DNH Regional Steward*, TNC Stewardship Director.

DELIVERABLE: Report of findings.

PRIORITY: high

◆ **OBJECTIVE 2C: Document and map vegetation types.**

DETAILED OBJECTIVE: Characterize, document, and inventory plant community types found on preserve and in vicinity; map location and extent of community types.

JUSTIFICATION: Knowledge of plant community composition and extent is needed to help refine conceptual ecological model, track changes in vegetation of the watershed over time, and guide management actions.

TASKS: Use aerial photography and other means to identify general types and extents of plant communities; conduct field survey to characterize and document community types and help define signature of community types on aerial photos; map location and extent of communities using aerial photos and extensive ground-truthing.

SCHEDULE: Undetermined.

PERSONNEL: Undetermined.

DELIVERABLE: Characterizations and maps of plant communities.

PRIORITY: medium.

◆ **OBJECTIVE 3A:** Research effectiveness of prescribed fire in the control of common reed.

DETAILED OBJECTIVE: Design and implement a small study to learn if carefully timed prescribed burning alone can be used as an effective means of controlling or suppressing the potentially invasive species, common reed.

JUSTIFICATION: Need to find less expensive and less environmentally damaging technique for effective control of common reed than herbicide and other established methods.

TASKS: Formulate project plan (ACTION PLAN), implement plan.

SCHEDULE: Pending filling of DNH Regional Steward position.

PERSONNEL: 1° - DNH Regional Steward*. 2° - TNC Stewardship Director, DNH Stewardship Director, VDoF staff.

DELIVERABLE: Final report of findings and recommendations.

PRIORITY: high

◆ **OBJECTIVE 3B:** Research effectiveness of fire in regenerating Atlantic white cedar.

DETAILED OBJECTIVE: Design and conduct research to determine the most effective methods and times to apply fire to regenerate Atlantic white cedar stands.

JUSTIFICATION: Atlantic white cedar communities appear dependent on fire for recruitment of seedlings and regeneration of stand; need to determine how and when to apply fire to best benefit Atlantic white cedar communities in the ecosystem.

TASKS: Undetermined.

SCHEDULE: Undetermined.

PERSONNEL: Undetermined.

DELIVERABLE: Report of findings and recommendations.

PRIORITY: medium

◆ **OBJECTIVE 3C:** Research effects of fire on pocosin and canebrake communities.

DETAILED OBJECTIVE: Design and implement a study of fire effects on pocosin and canebrake communities.

JUSTIFICATION: Pocosins and their related associations are fire dependent communities. Much area of these communities and their rare species are being lost to succession. Need to determine best methods for re-introducing fire into these areas to create and maintain rare natural communities and special habitats.

TASKS: A project proposal has been developed (ACTION PLAN), seek funding for project, implement project according to terms of proposal; project involves background research, land-owner contact, pre- and post-burn monitoring, and one to two pilot burns in pocosins.

SCHEDULE: Pending funding of project; implement as scheduled in proposal.

PERSONNEL: 1° - DNH Stewardship Director. 2° - TNC Stewardship Director, DNH Stewardship Biologist, DNH and TNC Stewardship Assistants, DSP Site Manager, VDoF staff, other cooperators.

DELIVERABLE: Implementation of burn on pocosin, summary of findings and recommendations.

PRIORITY: high

◆ **OBJECTIVE 3D:** Research effects of fire on marsh communities.

DETAILED OBJECTIVE: Design and implement a study to determine most effective methods and times to apply fire to marsh communities for purposes of natural heritage resource management.

JUSTIFICATION: Although marshes may not be naturally fire-dependent, fire can be used to manage marsh communities; need to establish techniques of burning most effective for management of marsh-related natural heritage resources.

TASKS: Develop a research proposal (ACTION PLAN), conduct study according to proposal; project will likely involve literature searches, pre- and post-burn vegetation monitoring, and several burns at different times of year.

SCHEDULE: Undetermined.

PERSONNEL: Undetermined.

DELIVERABLE: Summary of findings and recommendations, marsh burns.

PRIORITY: medium

◆ **OBJECTIVE 4A:** Evaluate effects of maintenance dredging of ICW.

DETAILED OBJECTIVE: Evaluate effects on ecosystem and natural heritage resources of the regular maintenance dredging of the Atlantic Intracoastal Waterway and disposal of dredged material in the North Landing River.

JUSTIFICATION: Effects of dredging and dredged material disposal on water quality, quantity, and natural heritage resources is unknown; need to assess influence of this activity on these resources and identify need for management or ameliorative measures.

TASKS: Undetermined.

SCHEDULE: Undetermined.

PERSONNEL: Undetermined.

DELIVERABLE: Report of findings and recommendations.

PRIORITY: medium

◆ **OBJECTIVE 4B:** Research extent and effect of salinity changes associated with bypass canal.

DETAILED OBJECTIVE: Design and implement a study (ACTION PLAN) to determine the extent of salt water intrusion into the North Landing River system from Canal Number Two and its bypass canal and the effects, if any, on the plant communities in the vicinity.

JUSTIFICATIONS: Extent of salt water intrusion and effects of vegetation from bypass canal are unknown; need to determine if salinities are significantly changed, what the effects on the plant communities are, and if ameliorative measures are necessary to protect or restore natural heritage resources in vicinity.

TASKS: Develop a project proposal, seek funding for proposal, and implement project according to proposal.

SCHEDULE: Undetermined.

PERSONNEL: Undetermined.

DELIVERABLE: Report of findings and recommendations.

PRIORITY: high

◆ **OBJECTIVE 5A:** Annually review and revise as necessary EOR's, SBR's, and TBR's.

DETAILED OBJECTIVE: Review and update Element Occurrence Records (EOR), Site Basic Records (SBR), and Tract Basic Records (TBR) in BCD for the preserve and vicinity every year.

JUSTIFICATION: Current information in BCD is needed for preserve management planning, protection efforts, the annual scorecard process, and accurate report generation.

TASKS: Submit hard copies of records to staff for review; compare records to field notes and other update information; make changes in computerized files; make appropriate changes in manual and map files.

SCHEDULE: An annual process that should be initiated and completed every winter.

PERSONNEL: 1° - DNH Information Specialist. 2° - DNH Conservation Planner.

DELIVERABLE: Current and correct EOR's, SBR's, and TBR's

PRIORITY: medium

◆ **OBJECTIVE 5B:** Enter and annually update stewardship actions.

DETAILED OBJECTIVE: Enter stewardship actions based on objectives of this management plan and on subsequent action plans into BCD; update these action records annually.

JUSTIFICATION: Current information in BCD is needed for preserve management planning, protection efforts, the annual scorecard process, and accurate report generation.

TASKS: Gather stewardship actions data from management plan and action plans; enter data into BCD; review actions records annually for status and revisions; update as appropriate.

SCHEDULE: An annual process that should be initiated and completed every winter.

PERSONNEL: 1° - DNH Information Specialist. 2° - DNH Conservation Planner.

DELIVERABLE: Current and correct stewardship action records in BCD.

PRIORITY: medium

◆ **OBJECTIVE 5C:** Produce an SSS annually.

DETAILED OBJECTIVE: Produce a site stewardship summary (SSS) based on updated EOR's, SBR's, TBR's, and stewardship action records for the preserve and vicinity every year.

JUSTIFICATION: Need an annual report from BCD to show measures of success in implementing management plan, provide up-to-date information for protection, access, and ecological management efforts, and helping with review and revision of management plan including site conservation plan.

TASKS: Use BCD reporting functions to generate site stewardship abstract.

SCHEDULE: An annual process that should occur in late winter to early spring following updates of BCD records.

PERSONNEL: 1° - DNH Information Specialist. 2° - DNH Conservation Planner.

DELIVERABLE: Site stewardship abstract.

PRIORITY: medium

◆ **OBJECTIVE 6A:** Provide appropriate environmental review of projects proposed in vicinity of preserve (See also Objectives 15A and 16A).

DETAILED OBJECTIVE: Provide environmental review upon request, including site information, natural heritage resource information, and impact avoidance/minimization recommendations, for development, road construction, and other projects proposed in the vicinity of the preserve.

JUSTIFICATION: Environmental review will help to facilitate the completion of appropriate projects while ensuring the protection of the integrity of the site and its resources.

TASKS: Respond promptly to requests for environmental review as they are received.

SCHEDULE: As needed.

PERSONNEL: 1° - DNH Project Review Coordinator*. 2° - DNH Regional Steward*.

DELIVERABLE: Project implementation with no or minimal impacts to natural heritage resources.

PRIORITY: high

◆ **OBJECTIVE 7A:** Periodically review management plan and revise as necessary.

DETAILED OBJECTIVE: Review the content of this preserve management plan on a regular periodic basis; revise the goals and objectives, when necessary, to reflect changes in knowledge and status of the site.

JUSTIFICATION: The management plan must retain a degree of flexibility in order to remain a useful document. The conditions and status of the preserve as well as our understanding of its habitats and natural heritage resources will change over time. A mechanism must be available to allow the management plan to adapt to these inevitable changes.

TASKS: Assemble a review committee of scientific experts, resource managers, and administrators; review plan; revise plan as appropriate; seek approval of VDCR Director.

SCHEDULE: First review of plan should take place two years after initial approval; subsequent reviews should occur every five years thereafter.

PERSONNEL: 1° - DNH Regional Steward*. 2° - DSP Site Manager, DNH Conservation Planner, DNH Stewardship Director, DNH Zoologist, DNH Botanist, DNH Ecologist, DNH Division Director, VDCR Director, Review Committee.

DELIVERABLE: Revised management plan.

PRIORITY: high

◆ **OBJECTIVE 7B:** Continue to refine site conservation plan.

DETAILED OBJECTIVE: Review and revise components of North Landing River ecosystem site conservation plans to reflect new knowledge of the structure and function of the system and of the resources it contains.

JUSTIFICATION: New information regarding the ecosystem and its biological resources will be discovered. Need to reflect the new knowledge in the resource assessment, stress assessment, and conservation planning boundaries to help achieve the most complete and efficient preservation of the natural heritage resources of the system.

TASKS: Assess new information regarding preserve, ecosystem, or similar systems resulting from work conducted either by VDCR or other entities as it becomes available; incorporate pertinent new information into site conservation plans; produce interim updated site conservation plans, if necessary; incorporate changes into next revision of management plan goals and objectives.

SCHEDULE: A continual process based on the availability of new information.

PERSONNEL: 1° - DNH Regional Steward*. 2° - DNH Conservation Planner, other scientific experts.

DELIVERABLE: Updated/revised site conservation plans.

PRIORITY: high

◆ **OBJECTIVE 7C:** Refine conceptual ecological model.

DETAILED OBJECTIVE: Review and revise conceptual ecological model as new information regarding the structure and function of the ecosystem is discovered.

JUSTIFICATION: New information regarding the ecosystem's structure and function will be discovered. Need to reflect the new knowledge in the conceptual ecological model to facilitate planning of effective ecological protection and management actions.

TASKS: Assess new information regarding ecosystem or similar systems resulting from work conducted by VDCR or others as it becomes available; incorporate pertinent new information into conceptual ecological model; revise model periodically to reflect changes; incorporate newest iteration of model in any revisions of management plan.

SCHEDULE: A continual process based on the availability of new information.

PERSONNEL: 1° - DNH Regional Steward*. 2° - various scientific experts.

DELIVERABLE: Revised conceptual ecological model.

PRIORITY: high

◆ **OBJECTIVE 7D:** Develop a fire management plan.

DETAILED OBJECTIVE: Develop a comprehensive fire management plan (ACTION PLAN) that addresses both wildfire and prescribed burning.

JUSTIFICATION: Fire management plan needed to state and justify wildfire and prescribed burn policies for the preserve, establish wildfire protocols for preserve, and provide comprehensive prescribed burning planning.

TASKS: Draft plan, solicit review, revise, solicit VDCR Director and TNC Fire Manager approval.

SCHEDULE: Pending filling of Regional Steward position.

PERSONNEL: 1° - DNH Regional Steward*. 2° - TNC Stewardship Director, DNH Stewardship Director, TNC Fire Manager, VDCR Department Director, VDoF staff.

DELIVERABLE: Fire management plan.

PRIORITY: medium

◆ **OBJECTIVE 8A: Complete acquisition of targeted tracts.**

DETAILED OBJECTIVE: Complete acquisitions and transfers of Sorey tract (VDCR), Miller tract (VDCR), and Woody/Old tract (TNC).

JUSTIFICATION: Acquisition of these high priority tracts is needed to secure protection of their highly significant natural heritage resources.

TASKS: Complete negotiation of land transactions and close the sales.

SCHEDULE: Closing date for Sorey tract should be by 5/95 and for Miller tract should be 11/95.

PERSONNEL: 1° - DNH Natural Areas Program Manager. 2° - VDCR Conservation and Development Program Supervisor, TNC Protection Director.

DELIVERABLE: Deed of VDCR ownership of tracts.

PRIORITY: high

◆ **OBJECTIVE 8B:** Complete dedication of all tracts owned by VDCR and TNC.

DETAILED OBJECTIVE: Attach Instruments of Dedication to the deeds of all tracts in the preserve owned by VDCR and TNC not already dedicated.

JUSTIFICATION: Natural area dedication is the strongest form of protection for natural heritage resources available. Dedication is needed on all tracts of the preserve to assure appropriate use and management in perpetuity.

TASKS: Draft instruments of dedication, solicit approval from all appropriate parties, record instruments with deeds.

SCHEDULE: VDCR tracts dedicated upon transfer; draft of instrument for pilot dedication of TNC tract completed and under review, remaining TNC tracts to be dedicated subsequent to pilot dedication.

PERSONNEL: 1° - DNH Natural Areas Program Manager. 2° - TNC Protection Director, VA Attorney General, TNC Regional Attorney.

◆ **OBJECTIVE 9A:** Secure management agreements or natural area registry on priority upland tracts.

DETAILED OBJECTIVE: Conduct property owner contact and education for key upland tracts and secure at least one management agreement and 20 natural area registries.

JUSTIFICATION: The preserve is not isolated from surrounding land-use and preservation of natural heritage resources is not assured just by protecting their habitat. Conservation of upland areas which influence preserve is needed.

TASKS: Meet and discuss conservation options with key land-owners, secure at least one management agreement on a priority tract targeted for Best Management Practices (BMP) demonstration (see Objective 13B), secure natural area registry on 20 privately owned tracts within watershed.

SCHEDULE: begin land-owner contact by 7/95, begin negotiations by 10/95, complete first natural area registry by 2/96 and first management agreement by 3/96.

PERSONNEL: 1° - DNH Natural Areas Program Manager. 2° - TNC Protection Director, DNH Protection Research Specialist, DCR Stewardship Director, TNC Stewardship Director.

DELIVERABLE: conservation of priority uplands; completed protection portfolio.

PRIORITY: high

◆ **OBJECTIVE 10A:** Conduct biological monitoring of selected rare species, problem species, and natural communities.

DETAILED OBJECTIVE: Conduct regular base-line biological monitoring of selected high priority or indicator rare species, problem species, and natural communities both on the preserve and elsewhere within the North Landing River ecosystem.

JUSTIFICATION: Base-line biological monitoring of natural heritage resources is needed to provide an indication of the success of active ecological management, help track population trends and indicate when active management is necessary, and assists with review of the management plan. Monitoring of potential problem species is needed to provide a means of determining the aggressiveness of a species at a site and if it is impacting natural heritage resources. Monitoring also furnishes a mechanism for measuring success of control initiatives if they are implemented. Monitoring should extend beyond the preserve's boundaries, where appropriate, to provide comprehensive information.

TASKS: Develop a biological monitoring plan (**ACTION PLAN**), implement regular monitoring as dictated by the plan, report on results regularly.

SCHEDULE: Pending filling of Regional Steward position.

PERSONNEL: 1° - DNH Regional Steward*. 2° - TNC Stewardship Director, DNH Stewardship Director, DNH and TNC Stewardship Assistants.

DELIVERABLE: Monitoring plan, annual report with monitoring data.

PRIORITY: medium

◆ **OBJECTIVE 11A: Complete common reed demonstration project.**

DETAILED OBJECTIVE: Continue and complete the common reed control demonstration project which includes, in part, the North Landing River Natural Area Preserve.

JUSTIFICATION: The common reed demonstration project should be continued to its culmination because it is providing valuable information and experience to land managers, facilitating public education regarding the common reed problem, establishing ecological management partnerships, and represents a contract obligation.

TASKS: Complete project as dictated by project proposal (ACTION PLAN); this includes implementation of prescribed burns, development of an educational slide show, continued biological monitoring of the control and treatment areas, analysis and reporting of results, and a strategic planning meeting among project cooperators to determine further steps on the common reed issue.

SCHEDULE: Burns to be conducted in 2/95 and possibly 5/95, progress report due 1/95, final report and recommendations due 1/96, slide show due 4/95, meeting to be held in late '95.

PERSONNEL: 1° - DNH Stewardship Biologist. 2° - DNH Stewardship Director, project cooperators.

DELIVERABLE: Progress report, final report, slide show, meeting, controlled common reed stands.

PRIORITY: high

◆ **OBJECTIVE 11B:** Re-introduce fire to the pocosins.

DETAILED OBJECTIVE: Re-introduce fire into the pocosin and related associations of the preserve via carefully planned and safely implemented prescribed burns.

JUSTIFICATION: Pocosins and their related associations (open bog, pond pine swamp) are fire dependent communities. Much area of these associations and their rare species are being lost to succession. Need to re-introduce fire into these areas to create and maintain the rare natural communities and special habitats.

TASKS: Tasks will follow recommendations of pocosin burn study (see Objective 3C) and fire management plan (see Objective 7D).

SCHEDULE: Pending completion of pocosin burn study and fire management plan.

PERSONNEL: 1° - DNH Regional Steward*. 2° - DNH Stewardship Director, TNC Stewardship Director, DNH Stewardship Biologist, DNH and TNC Stewardship Assistants, DSP Site Manager, VDoF staff, other cooperators.

DELIVERABLE: Implementation of prescribed burns in pocosins, fire summary and other reports.

PRIORITY: high

◆ **OBJECTIVE 11C:** Utilize fire as a marsh management tool.

DETAILED OBJECTIVE: Periodically conduct prescribed burns in the marshes of the preserve to enhance natural heritage resources and other habitats and communities.

JUSTIFICATION: Marshes will benefit from burning. Need to burn marshes periodically to help stimulate growth and reproduction of plants, stress invasive species, slow natural succession by woody plants, and enhance rare species and other wildlife habitat.

TASKS: Tasks will follow recommendations of marsh burn study (see Objective 3D); burn units, burn plans, and rotations will be included in fire management plan (see Objective 7D), implement burns according to plans in cooperation with VDoF, USFWS, and other partners.

SCHEDULE: Pending completion of marsh burn study.

PERSONNEL: 1° - DNH Regional Steward¹. 2° - DNH Stewardship Director, TNC Stewardship Director, TNC and DNH Stewardship Assistants, VDoF staff, other fire management cooperators.

DELIVERABLE: Implementation of prescribed burns, fire summary reports.

PRIORITY: medium

◆ **OBJECTIVE 11D:** Develop and implement a problem species assessment and control plan (ACTION PLAN).

DETAILED OBJECTIVE: Assess the threat of problem species, such as common reed and nutria, to the ecosystem, specific associations, and specific taxa based on biological monitoring information (see Objective 10A) and other data; develop plans to control or suppress problem species which are imminently threatening natural heritage resource viability.

JUSTIFICATION: Potential problem species may pose major, minor, or no threat to natural heritage resources of a site. Need to establish which problem species, if any, represent major threats to natural heritage resources. Need to formulate a realistic plan of control activities to attenuate any major threats identified.

TASKS: Gather information, develop assessment and plan, coordinate with conservation partners and adjacent landowners, implement plan.

SCHEDULE: Pending filling of Regional Stewardship position.

PERSONNEL: 1° - DNH Regional Steward'. 2° - TNC Stewardship Director, DNH Stewardship Director.

DELIVERABLE: Assessment and plan, control of problem species.

PRIORITY: high

◆ **OBJECTIVE 12A:** Continue to manage duck hunting adjacent to preserve in cooperation with VDGIF.

DETAILED OBJECTIVE: Continue efforts in cooperation with VDGIF to guide and manage duck hunting activities on and adjacent to preserve.

JUSTIFICATION: Need to manage duck hunting to ensure natural heritage resources are protected, public safety is addressed, and waterfowl populations are appropriately managed.

TASKS: Continue to hold annual meetings with VDGIF regarding duck hunting, assist VDGIF with any information needs or active management.

SCHEDULE: Annual meetings should take place annually well before waterfowl season.

PERSONNEL: 1° - DNH Regional Steward*, TNC Stewardship Director.
2° - VDGIF staff.

DELIVERABLE: Appropriately managed duck hunting.

PRIORITY: low

◆ **OBJECTIVE 12B:** Develop and implement a deer hunting plan and guidelines (ACTION PLAN).

DETAILED OBJECTIVE: Develop a plan for management for deer hunting on preserve which contains guidelines for administration and implementation deer hunting; secure any necessary leases and agreements and implement plan.

JUSTIFICATION: Comprehensive deer hunting guidelines for the preserve have not been determined. Deer hunting could be conducted on the preserve for resource management purposes, in exchange for site management services, or as a retained property right. Deer hunting regulations differ from tract to tract respective of ownership and conditions of transfer. A comprehensive deer hunting plan and guidelines are needed to resolve deer hunting issues and appropriately manage and administer any deer hunting on the preserve while ensuring preservation of natural heritage resources.

TASKS: Develop a plan and guidelines in cooperation with VDGIF, implement terms of plan according to guidelines.

SCHEDULE: Undetermined, pending revision of VDCR hunting regulations for natural area preserves and review of TNC hunting guidelines.

PERSONNEL: Undetermined.

DELIVERABLE: Deer hunting plan and guidelines.

PRIORITY: low

◆ **OBJECTIVE 13A:** Develop a model land use plan (ACTION PLAN) for priority for priority upland tracts.

DETAILED OBJECTIVE: Evaluate possible strategies for water quality and quantity conservation on upland tracts influencing the preserve and develop a model land-use plan which outlines the most effective measures.

JUSTIFICATION: The preserve is not isolated from land uses beyond its boundaries; need to evaluate and recommend land-use strategies for adjacent tracts that will help preserve the natural heritage resources of the preserve.

TASKS: Evaluate data from hydrology study and other sources and develop strategies for land-use, complete model land-use plan and present to appropriate agencies and landowners.

SCHEDULE: Submit model plan by 9/30/95.

PERSONNEL: 1° - VDSWCD staff. 2° - TNC Stewardship Director, VDCR Stewardship Director, VDCR Regional Steward'.

DELIVERABLE: Model land-use plan.

PRIORITY: medium

◆ **OBJECTIVE 13B:** Design and implement a demonstration water quality conservation project.

DETAILED OBJECTIVE: Design and implement a water quality conservation project on a farm as a demonstration of land use compatible with the preservation of natural heritage resources on the preserve.

JUSTIFICATION: The preserve is not isolated from land uses beyond its boundaries; need to implement a water quality conservation project as a demonstration of practices that will help preserve the natural heritage resources of the preserve.

TASKS: Make landowner contacts (see Objective 9A), select a demonstration farm and secure a management agreement with owner (see Objective 9A), complete farm conservation plan (ACTION PLAN) and implement water quality BMP's and water quality monitoring.

SCHEDULE: Select farm by 9/30/95, complete plan by 12/15/95, install BMP's by 7/96.

PERSONNEL: 1° - VDSWCD staff. 2° - VDCR Stewardship Director, TNC Stewardship Director, VDCR Regional Steward*, VDCR Protection Research Specialist.

DELIVERABLE: Farm conservation plan, BMP's implemented on demonstration farm.

PRIORITY: medium

◆ **OBJECTIVE 14A:** Complete development of public access facilities at Kellam tract.

DETAILED OBJECTIVE: Complete construction of the access road, parking area, boardwalk, canoe launch and other facilities designed for the Kellam tract.

JUSTIFICATION: Because of topography and lack of road frontage, public access opportunities to preserve are limited. Need to provide access facilities to preserve. This access site will also provide a setting for interpretive and educational facilities and programs.

TASKS: Facilities have been designed, most approvals and permits have been obtained; final permitting, contracting of labor/materials, and actual construction remain.

SCHEDULE: Time-line dependent on final permit approvals, bidding process, and weather during construction period, but facilities should be in place by 6/95.

PERSONNEL: 1° - DNH Landscape Architect. 2° - DSP Site Manager, DNH Natural Areas Program Manager.

DELIVERABLE: Completion of facilities.

PRIORITY: low

◆ **OBJECTIVE 14B:** Develop and implement a comprehensive public access and recreation assessment and plan (**ACTION PLAN**).

DETAILED OBJECTIVE: Based on the recommendations of the Advisory Team, develop an assessment of current public access and recreation opportunities, demands for access and recreation, and recommendations for meeting the access and recreation demands and integrating access and recreation development with local efforts within the preservation purpose of the site. Implement the recommendations of the plan.

JUSTIFICATION: As a tertiary purpose for the establishment of the site is to provide outdoor recreation opportunities, an assessment and plan is needed to address these issues while maintaining the biodiversity of the site.

TASKS: Assemble an assessment and planning committee, develop assessment and plan, implement recommendations of plan.

SCHEDULE: Complete plan and assessment by 3/96; complete implementation according to schedule in plan.

PERSONNEL: For plan development: 1° - DPRR Recreation Planner. 2° - DNH Landscape Architect, DSP Site Manager, DNH Regional Steward*, Recreation and Access Assessment and Planning Committee. For plan implementation: 1° - DNH Landscape Architect. 2° - DSP Site Manager, DNH Regional Steward*, other cooperators.

DELIVERABLE: Assessment and plan; public access and recreation facilities.

PRIORITY: low

◆ **OBJECTIVE 15A:** Review proposed projects for potential impacts to scenic resources (see also Objective 6A).

DETAILED OBJECTIVE: Review all proposed site management projects and other projects which may affect the site's or surrounding's scenic resources for potential visual impacts and assure that visual concerns are addressed before project implementation.

JUSTIFICATION: Need to preserve all natural and cultural resources of the site, including scenic resources. Review of projects for possible visual impacts will assure that no avoidable scenic impacts occur.

TASKS: Review projects as they are proposed; make recommendations to avoid or minimize scenic impacts.

SCHEDULE: As needed.

PERSONNEL: 1° - DPRR Scenic Resources Specialist. 2° - DSP Site Manager, DNH Landscape Architect, DNH Regional Steward*.

DELIVERABLE: Uncompromised scenic resources.

PRIORITY: low

◆ **OBJECTIVE 15B:** Encourage a regional approach to scenic resources management.

DETAILED OBJECTIVE: Based on the recommendations of the Management Planning Advisory Team, encourage a regional approach involving public and private property owners, local and regional government, and other conservation agencies and organizations towards comprehensive preservation of scenic resources within the North Landing River Watershed.

JUSTIFICATION: Viewshed management units can extend only as far as TNC or VDCR ownership, but viewsheds from the preserve can be interrupted by activities outside the preserve. Therefore, need to develop a regional approach to scenic resources preservation.

TASKS: Regional cooperation has already begun through completion of public access and visual resources study (Potter 1994). Assemble representatives who have an interest in or influence over scenic resources in the watershed, develop a regional scenic resources plan (ACTION PLAN), implement recommendations of plan.

SCHEDULE: Hold initial meeting of working group by 10/95; complete plan by 10/96.

PERSONNEL: 1° - DPRR Planner. 2° - members of working group.

DELIVERABLE: Regional scenic resources plan; intact scenic resources.

PRIORITY: low

◆ **OBJECTIVE 16A:** Review proposed projects for potential impacts to historic resources (see also Objective 6A).

DETAILED OBJECTIVE: Review any proposed construction of public access or other facilities through Department of Historic Resources for assessment of possible impact to historic resources and recommendations regarding how to avoid or minimize potential impacts.

JUSTIFICATION: Need to preserve all natural and cultural resources of the site, including historic resources. Review of projects for possible historic resource impacts will assure that no avoidable impacts occur and that unavoidable impacts are minimized.

TASKS: Request review of proposed projects by Department of Historic Resources; implement recommendations to best capability within preservation purview of site.

SCHEDULE: As needed.

PERSONNEL: 1° - DNH Landscape Architect. 2° - DSP Site Manager, DHR Project Review Supervisor.

DELIVERABLE: Completed project with no or minimal impacts to historic resources.

PRIORITY: low

◆ **OBJECTIVE 17A:** Establish and maintain appropriate signage.

DETAILED OBJECTIVE: Establish and maintain entrance, directional, boundary, rules, interpretive and other signage at the preserve in order to enhance enjoyment of the site by visitors, provide for environmental education, and encourage compliance with resource protection and safety rules.

JUSTIFICATION: Because sufficient staff does not exist to guide, educate, and supervise each visitor to the preserve, signs are needed to provide pleasant and educational visits to the preserve while assuring safety and resource protection.

TASKS: Design signs for the site including entrance, directional, rules, boundary, and interpretive signs; have signs manufactured; install signs; maintain and replace signs as necessary.

SCHEDULE: As needed or in relation to other site development projects.

PERSONNEL: 1° - DSP Site Manager. 2° - DNH Landscape Architect, DNH Regional Steward, TNC Stewardship Director, Stewardship Volunteers.

DELIVERABLE: Signs.

PRIORITY: low

◆ **OBJECTIVE 17B:** Implement effective site security.

DETAILED OBJECTIVE: Provide adequate site security measures including patrolling, enforcement, signage, and education.

JUSTIFICATION: Need to assure resource protection rules and regulations are followed and that visitor safety is addressed.

TASKS: Complete marking of all boundaries with appropriate signs, periodically patrol site and implement law enforcement actions as necessary, educate visitors regarding preserve use rules.

SCHEDULE: Continuous.

PERSONNEL: 1° - DSP Site Manager or TNC Stewardship Director. 2° - DNH Regional Steward*, TNC Stewardship Assistant.

DELIVERABLE: Marked boundaries, increased public awareness, incident reports, etc.

PRIORITY: medium

◆ OBJECTIVE 17C: Maintain access facilities and other amenities.

DETAILED OBJECTIVE: Maintain, replace, and repair existing facilities designed for public access or other purposes; this refers primarily to access roads, parking areas, boardwalks, restrooms, picnic tables, and the other facilities in the public access areas.

JUSTIFICATION: Existing facilities must be properly maintained to retain their effectiveness and safety.

TASKS: Maintain, replace, or repair the existing facilities and maintain, replace, or repair any future facilities.

SCHEDULE: As needed.

PERSONNEL: 1° - DSP Site Manager or TNC Stewardship Director (respective of tract ownership).

DELIVERABLE: Well-maintained facilities.

PRIORITY: low

◆ **OBJECTIVE 18A:** Develop and distribute written educational materials.

DETAILED OBJECTIVE: Design, produce, and update written educational materials, such as fact sheets, regarding the preserve, its ecosystem, and its resources.

JUSTIFICATION: Educational materials can be distributed to the public through direct contact, special events, direct mailings, or at presentations and used to increase public awareness of the significance and ecology of the site and to help promote appropriate visitation of the preserve.

TASKS: Preserve fact sheet, pocosin fact sheet, and cypress/tupelo swamp fact sheet already developed, update preserve fact sheet, develop fact sheets on marshes and selected rare species.

SCHEDULE: Updated preserve fact sheet by 5/95; other fact sheets and brochures developed as resources allow.

PERSONNEL: 1° - DSP Site Manager. 2° - DNH and TNC Stewardship Assistants, DVCS Public Communications Manager, DNH Regional Steward*

DELIVERABLE: Updated preserve fact sheet, additional fact sheets and brochures.

PRIORITY: low

◆ **OBJECTIVE 18B:** Provide educational programs.

DETAILED OBJECTIVE: Provide field tours, presentations, and other educational programs designed to increase public awareness of the preserve, its resources, and its ecosystem.

JUSTIFICATION: Educational programs are needed to increase public awareness to biodiversity and other ecological issues, explain basic ecologic principles, and engender support for the preserve, natural heritage resource preservation, and conservation programs in general.

TASKS: Provide guided educational tours of preserve; give presentations regarding the preserve to school groups, civic associations, special interest groups, etc; display educational exhibits at special events or community gathering places; develop other educational programs.

SCHEDULE: Tours to be provided upon sufficient demand or when deemed appropriate by staff; presentations provided upon request when resources allow; display exhibits as opportunities arise, implement other programs when appropriate.

PERSONNEL: 1° - DSP Site Manager. 2° - DNH and TNC Stewardship Assistants, DVCS Public Communications Manager, TNC Director of Communications.

DELIVERABLES: Tours, presentations, exhibits, other educational programs.

PRIORITY: low

◆ **OBJECTIVE 18C:** Appropriately promote preserve.

DETAILED OBJECTIVE: Promote greater awareness of the preserve and appropriate visitation through a variety of techniques including press releases, mapping, other publications, and remote signage.

JUSTIFICATION: Promotional programs are needed to increase public awareness of the existence of the preserve and preserve system, biodiversity and other ecological issues, to engender support for the preserve, natural heritage resource preservation, and conservation programs in general, and to encourage appropriate visitation and use of the site. **Promotional programs must always balance visitation with the needs of the natural heritage resources of the site.**

TASKS: Arrange for an articles to appear in local and/or regional newspapers about the preserve; consider whether to have the preserve included on state road maps and other maps utilized by travelers; consider whether to have preserve included in other publications, such as state parks brochures or local or state-wide magazines; consider directional signage off-site designed to guide visitors to the preserve.

SCHEDULE: Continuous.

PERSONNEL: 1° - DSP Site Manager. 2° - TNC Communications Director, TNC and DNH Stewardship Assistants, DNH Regional Steward*, DVCS Public Communications Manager.

DELIVERABLE: Newspaper articles, maps showing preserve (?), articles in other publications (?), off-site signage (?).

PRIORITY: low

◆ **OBJECTIVE 19A:** Coordinate management between VDCR and TNC.

DETAILED OBJECTIVE: Coordinate management planning and activities between TNC and VDCR.

JUSTIFICATION: Management coordination efforts are needed to facilitate timely and effective cooperative management efforts and assure that management planning and implementation initiatives are completed appropriately.

TASKS: Determine responsibilities for cooperative management and any issues which will be managed independently. Coordinate management informally by diligent efforts to keep communications open and assist each other in accomplishing tasks. Coordinate management formally through quarterly meetings of VDCR and TNC management staff in which progress and status of management actions are reviewed.

SCHEDULE: Continuous, meetings quarterly.

PERSONNEL: 1° - DNH Regional Steward^{*} and TNC Stewardship Director. 2° - VDCR NAMT, DSP Site Manager.

DELIVERABLE: Coordinated management efforts.

PRIORITY: medium

◆ **OBJECTIVE 19B:** Coordinate management with other existing partners (see also Objectives 2A, 2B, 3A, 7A, 7B, 7C, 7D, 11A, and 17A which require involvement of other conservation partners).

DETAILED OBJECTIVE: Coordinate planning, site management, and ecological management efforts among VDCR, TNC and other existing management partners such as the Virginia Department of Forestry, the Virginia Department of Game and Inland Fisheries, the U.S. Fish and Wildlife Service (USFWS), and the U.S Army Corps of Engineers.

JUSTIFICATION: Management coordination efforts are needed to facilitate timely and effective cooperative management efforts and assure that management planning and implementation initiatives are completed appropriately.

TASKS: Coordinate management informally by diligent efforts to keep communications open and assist each other in accomplishing tasks. Coordinate management formally through meetings of VDCR and TNC management staff with other management partners in which progress and status of management actions are reviewed.

SCHEDULE: Continuous, meetings as needed.

PERSONNEL: 1° - DNH Regional Steward^{*} and TNC Stewardship Director. 2° - VDCR NAMT, other management partners.

DELIVERABLE: Coordinated management efforts.

PRIORITY: medium

◆ **OBJECTIVE 20A:** Establish a Stewardship Advisory Committee.

DETAILED OBJECTIVE: VDCR and TNC will jointly establish a Stewardship Advisory Committee consisting of representatives of local governments, state and federal resource management agencies, scientific experts, and other appropriate individuals whose purpose shall be to advise and assist TNC, VDCR, and their management partners in the management of the preserve and act as advocates for the preserve in the community.

JUSTIFICATION: VDCR and TNC lack the complete expertise and knowledge of all aspects of the North Landing River ecosystem to effectively manage the preserve alone. An advisory group is necessary to help fill gaps in knowledge of the system and to act as advocates for the preserve in the community.

TASKS: Compose a list of candidates for membership on the Stewardship Advisory Committee, invite candidates to participate, host quarterly meetings of group and utilize group for information and other needs.

SCHEDULE: Produce list of candidates and alternates by 5/95, invite candidates to participate by 7/95, conduct first quarterly meeting by 11/95 and quarterly thereafter.

PERSONNEL: 1° - DNH Regional Steward*. 2° - DNH Stewardship Director, TNC Stewardship Director.

DELIVERABLE: Functional stewardship advisory committee.

PRIORITY: low

◆ **OBJECTIVE 20B:** Enlist support of private landowners and community organizations.

DETAILED OBJECTIVE: Solicit support and assistance with certain preserve management tasks from neighboring private land-owners and local community organizations, and other volunteers.

JUSTIFICATION: Since VDCR and TNC land management resources are limited, assistance from local residents, community organizations, and other volunteers is needed.

TASKS: Solicit assistance from local residents and community organizations for specific tasks or in general depending upon need and opportunity.

SCHEDULE: As needed.

PERSONNEL: Variable.

DELIVERABLE: Management assistance from residents or organizations.

PRIORITY: medium

MANAGEMENT UNITS

Management units are parcels of land within the preserve delineated based on land use and receiving a particular management treatment. Management units indicate compatible uses within defined areas on a property. Some management units may be mutually exclusive or adjacent, but others may overlap or be nested.

The State Lands Resource Management Plan Guide developed by the VDCR Lands Classification Committee lists the following thirteen types of management units:

- concentrated use,
- support/administrative,
- historical and cultural use,
- dispersed recreation,
- viewshed,
- natural area preserve,
- zoological/botanical,
- geologic,
- wildlife,
- timber,
- agricultural,
- scenic river, and
- control limitation and special use.

North Landing River Natural Area Preserve contains three types of management units: natural area preserve, concentrated use, and scenic river.

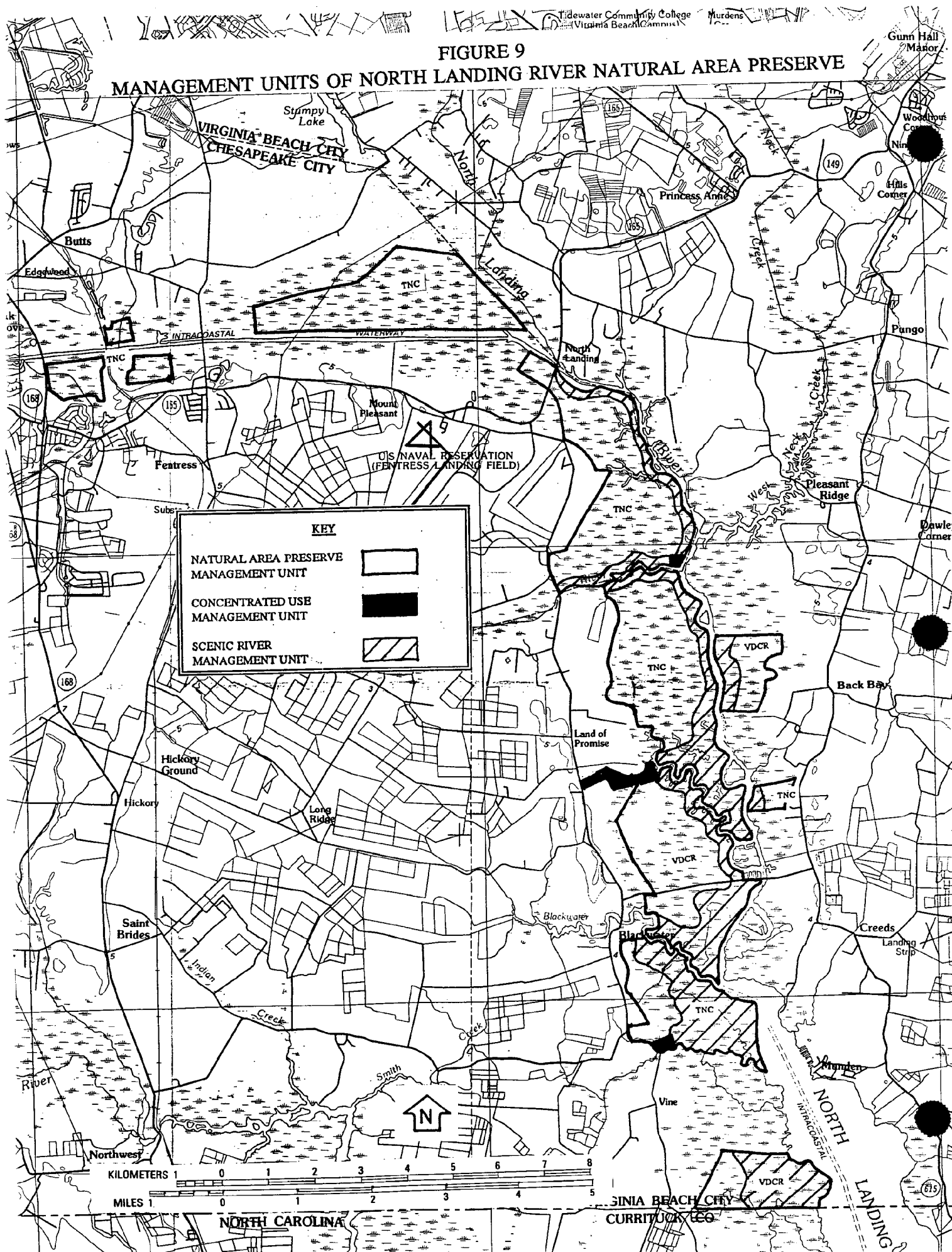
MANAGEMENT UNIT DELINEATION

The extent of the management units are mapped in Figure 9 and discussed below. Although the management units encompass both TNC and VDCR tracts, ultimate management authority and responsibility for a tract lies with the owner.

The entire extent of the properties of the natural area preserve comprise the **natural area preserve management unit**. All other management units are nested within the natural area preserve management unit.

The **concentrated use management units** center on the public access

FIGURE 9
MANAGEMENT UNITS OF NORTH LANDING RIVER NATURAL AREA PRESERVE



areas. There are three concentrated use management units. These units include the parking lot and boardwalk on the Dozier tract, the proposed access facilities on the Kellam tract, and the observation platform on the City of Chesapeake tract.

The **scenic river management unit** includes scenic buffers on either side of the North Landing River and its tributaries that have been designated as state scenic rivers. Generally, the buffer includes all open lands adjacent the river and a minimum 100 foot scenic buffer strip of forest beyond the river or open land to preserve the viewshed from the river.

MANAGEMENT STANDARDS

Management standards reflect the management direction set in the goals and objectives and further define and direct land use for each management unit. Standards ensure that land uses are compatible within a management unit and among management units. On the following pages, the intent of each management unit is summarized as the "desired future" and management standards for 15 land use categories are stated.

Because TNC has ultimate authority and responsibility for management of the tracts they own, the management standards presented below may not apply to TNC-owned property in some situations.

Management Standards for Natural Area Preserve Management Unit

Desired Future

Natural area preserve management units consist of areas on private or public land which have been dedicated as natural area preserves. Formal classification of these units can only occur with the approval of the VDCR Director and an ecological assessment and recommendation by the Division of Natural Heritage. The purpose of this management unit is to preserve natural heritage resources. Only uses compatible with this purpose are permitted. The natural area preserve management unit encompasses the entire preserve; other management units are nested within this unit. In any situation where the management standards of the natural area preserve management unit and the standards of other units appear to conflict, the standards for the natural area preserve unit assume priority.

Standards

Geologic and Soil Resources

Removal or alteration of geologic or soil resources is prohibited, except for small alterations necessary to develop public access facilities or to provide for ecological management.

Water Quality

All activities within this management unit must be conducted in a manner to avoid or minimize impacts to water quality.

Air Quality

Prescribed burning shall be conducted only in compliance with VDEQ air quality regulations and VDoF smoke management guidelines. Burn plans must delineate smoke management strategies.

Landscape Management

Anthropogenic landscaping is prohibited, except within concentrated use management units for purposes of facilitating or enhancing public access or enjoyment and within the scenic river management unit for purposes of providing a visual buffer. Plantings shall be of native stock whenever possible. If non-native stock must be used, only non-invasive species shall be planted.

Agriculture

Agriculture uses prohibited.

Watercourses	Watercourses shall not be altered or impounded, except for purposes of restoration to a natural condition.
Wetlands	Wetlands shall not be altered, except that small areas of wetlands within concentrated use management units may be altered under certain circumstances and conditions to facilitate approved public access (see concentrated use management prescription) and that wetlands may be altered to restore an area to natural conditions for purposes of natural heritage resource management. Projects will comply with local, state, and federal wetlands regulations at all times.
Insect and Disease	Programs to control insect and disease outbreaks are prohibited, except for purposes of protecting natural heritage resources or natural ecological processes or when a public health emergency is declared. Any control programs implemented under the above conditions must have approval of the tract owner or be mandated by law.
Forest Resources	Management of forest resources solely for fiber production is prohibited. When necessary to meet natural heritage resource management needs, limited forest management activities may be permitted.
Historic Resources	Any artifacts, archaeological sites, historic structures, or other historic resources discovered on the site will be managed for preservation. If compatible with preservation of historic and natural heritage resources, interpretation and research of historic resources may be permitted.
Recreation Resources	Recreational uses shall be permitted only if they are compatible with preservation of natural heritage resources. Recreational use will generally be limited to the concentrated use management units.
Scenic Resources	Scenic resources shall be preserved, except where their alteration is necessary for natural heritage resource management.

**Natural Heritage
Resources**

Preservation of natural heritage resources is the principal purpose of this management unit. Only land uses which either further the preservation intent or do not interfere with the preservation intent are permitted. Habitat manipulation and protective measures favoring natural heritage resources shall be undertaken as specified in the goals and objectives of this resource management plan.

**Collection of Natural or
Historic Resources**

Collection of natural or historic resources is prohibited, except with a valid permit from VDCR or TNC and any other applicable agencies.

**Fish and Wildlife
Resources**

Management actions intended to augment fish and wildlife populations solely for the enhancement of recreational hunting, fishing, or trapping are prohibited. Waterfowl hunters may enter the unit to search for downed waterfowl. Deer hunting rights have been retained on certain tracts by the previous owners. Hunting and trapping for resource management purposes may occur under the guidance of a plan.

Management Standards for Concentrated Use Management Units

Desired Future

Concentrated use management units generally include areas which serve concentrations of people, such as day use areas, visitor services facilities, and water access areas. The purpose of the concentrated use management units is to provide public access to the preserve and direct the public to less sensitive parts of the site. Generally, low-intensity public uses such as birding, photography, and non-manipulative educational activities are encouraged within this unit. Natural heritage resource management shall retain priority over any and all public access development or recreational within this unit.

Standards

Geologic and Soil Resources

Removal or alteration of geologic or soil resources is prohibited, except for small alterations necessary to develop public access.

Water Quality

All activities within this management unit must be conducted in a manner to avoid or minimize impacts to water quality.

Air Quality

Prescribed burning is generally not conducted within concentrated use management units, but any burning that is conducted shall follow the same air quality standards of the natural area preserve management unit.

Landscape Management

Landscaping and related work may occur for purposes of facilitating or enhancing public access or enjoyment or for minimizing erosion associated with construction projects. Plantings shall be of native stock whenever possible. If non-native stock must be used, only non-invasive species shall be planted.

Agriculture

Agriculture uses prohibited.

Watercourses

Watercourses shall not be altered or impounded, except for purposes of restoration to a natural condition.

Wetlands	Small areas of wetlands may be altered only if other options to avoid wetland alteration are not reasonably possible. If wetlands must be altered, impacts will be minimized to the greatest extent possible and the project will comply with local, state and federal wetlands regulations at all times.
Insects and Disease	Programs to control insect and disease outbreaks are prohibited, except for purposes of protecting natural heritage resources or natural ecological processes or when a public health emergency is declared. Any control programs must have approval of the tract owner or be mandated by law.
Forest Resources	Generally, management of forest resources solely for fiber production is prohibited. When necessary to facilitate public access, limited forest management activities may be permitted if they are compatible with natural heritage resource preservation.
Historic Resources	Any artifacts, archaeological sites, historic structures, or other historic resources discovered on the site will be managed for preservation. If compatible with preservation of historic and natural heritage resources, interpretation and research of historic resources may be permitted.
Recreation Resources	Recreational uses shall be permitted only if they are compatible with preservation of the natural heritage resources. Recreational uses of the preserve will generally be restricted to these units.
Scenic Resources	Scenic resources shall be preserved, except where their alteration is necessary for natural heritage resource management.
Natural Heritage Resources	Preservation of natural heritage resources is the principal purpose of this site. Only public access and use which is compatible with natural heritage resource preservation shall be permitted. Habitat manipulation and protective measures favoring natural heritage resources shall be undertaken as specified in the goals and objectives of this resource management plan.
Collection of Natural or Historic Resources	Collection of natural or historic resources is prohibited, except with a valid permit from VDCR or TNC and any other applicable agencies.

**Fish and Wildlife
Resources**

Management actions intended to augment fish and wildlife populations solely to enhance recreational hunting, fishing, and trapping are prohibited. Hunting and fishing are generally prohibited within concentrated use management units.

Management Standards for Scenic River Management Unit

Desired Future

The Virginia State Scenic Rivers Act provides formal recognition of scenic waterways, but does not provide scenic buffers or other viewshed protection measures. Scenic river management units generally include the shores of state or federally designated scenic waterways and protect the largely primitive and pristine visual surrounding of the waterway with an adequate scenic visual buffer. The purpose of this management unit is to provide a visual buffer to the designated state scenic waterway. Natural heritage resource management shall retain priority over any and all scenic resource protection measures.

Standards

Geologic and Soil Resources

Removal or alteration of geologic or soil resources is prohibited, except for small alterations necessary to develop public access or ecological management facilities.

Water Quality

All activities within this management unit must be conducted in a manner to avoid or minimize impacts to water quality.

Air Quality

Prescribed burning shall be conducted only in compliance with VDEQ air quality regulations and VDoF smoke management guidelines. Burn plans must delineate smoke management strategies.

Landscape Management

Anthropogenic landscaping is prohibited, except where necessary to provide adequate visual buffers. Plantings shall be of native stock whenever possible. If non-native stock must be used, only non-invasive species shall be planted.

Agriculture

Agriculture uses prohibited.

Watercourses

Watercourses shall not be altered or impounded, except for purposes of restoration to a natural condition.

Wetlands	Wetlands shall not be altered, except that small areas of wetlands within concentrated use management units may be altered under certain circumstances and conditions to facilitate public access (see concentrated use management prescription) and that wetlands may be altered to restore an area to natural conditions for purposes of natural heritage resources management. Projects will comply with local, state, and federal wetlands regulations at all times.
Insects and Disease	Programs to control insect and disease outbreaks are prohibited, except for purposes of protecting natural heritage resources or natural ecological processes or when a public health emergency is declared. Any control programs implemented under the above conditions must have approval of the tract owner or be mandated by law.
Forest Resources	Generally, management of forest resources solely for fiber production is prohibited. When necessary to meet natural heritage resource management needs, limited forest management activities may be permitted.
Historic Resources	Any artifacts, archaeological sites, historic structures, or other historic resources discovered on the site will be managed for preservation. If compatible with preservation of scenic, historic, and natural heritage resources, interpretation and research of historic resources may be permitted.
Recreation Resources	Recreational uses shall be permitted only if they are compatible with preservation of the scenic and natural heritage resources. Recreational use will generally be limited to the concentrated use management units.
Scenic Resources	Adequate visual buffers between the scenic waterway and visual intrusions shall be provided.
Natural Heritage Resources	Only land uses which are compatible with natural heritage resource preservation are permitted. Habitat manipulation and protective measures favoring natural heritage resources shall be undertaken as specified in the goals and objectives of this resource management plan.
Collection of Natural or Historic Resources	Collection of natural or historic resources is prohibited, except with a valid permit from VDCR or TNC and any other applicable agencies.

**Fish and Wildlife
Resources**

Management actions intended to augment fish and wildlife populations strictly for the purpose of enhancing recreational fishing, hunting, or trapping are prohibited. Waterfowl hunters may enter the unit to search for downed waterfowl. Deer hunting rights have been retained on certain tracts by the previous owners. Hunting and trapping for resource management purposes may occur under the guidance of a plan.

ACTION PLANS

Action plans are documents which outline in more detail than a management synopsis the steps that will be taken to accomplish an objective. Action plans are generally recommended in situations where the number and complexity of tasks needed to reach an objective exceed the capacity of a management synopsis alone. Action plans are often utilized when evaluations of existing conditions or team planning efforts are needed. Action plans normally include budget and schedule information. Many action plans consist of project proposals or grant applications.

The management synopses recommend the development of 15 action plans. Table 8 lists the 15 action plans along with the applicable objective and whether the action plan is existing or proposed.

TABLE 8

**ACTION PLANS FOR THE
NORTH LANDING RIVER NATURAL AREA PRESERVE**

ACTION PLAN TITLE	RELATED OBJECTIVE	EXISTING/PROPOSED
Hydrologic and Geochemical Investigations of the wetlands of the North Landing River	2A: Continue hydrologic, geochemical and vegetation research.	existing
Fire History Investigations of the Pocosins of the North Landing River and the Great Dismal Swamp	2B: Continue fire and vegetation history research.	existing
Trial Use of Prescribed Burning for the Control of Common Reed	3A: Research effectiveness of prescribed fire in the control of common reed.	proposed
Restoring a Wetland Ecosystem: a Fire Management Proposal for the North Landing River Wetlands	3C: Research effects of fire on pocosin and canebrake communities.	existing
Use of Prescribed Fire as a Management Tool for the Marshes of the North Landing River	3D: Research effects of fire on marsh communities.	proposed
Salinity Changes and Effects on Vegetation in West Neck Creek and the North Landing River	4B: Determine extent and effect of salinity changes associated with bypass canal.	proposed
North Landing River Natural Area Preserve Fire Management Plan	7D: Develop a fire management plan.	proposed
North Landing River Natural Area Preserve Biological Monitoring Plan	10A: Conduct biological monitoring of selected rare species, problem species, and natural communities.	proposed
Control of Common Reed in the Southern Watersheds: a Habitat Demonstration Project	11A: Complete common reed demonstration project.	existing
North Landing River Natural Area Preserve Problem Species Assessment and Control Recommendations	11D: Develop and implement a problem species assessment and control plan.	proposed

TABLE 8 (CONTINUED)

ACTION PLAN TITLE	RELATED OBJECTIVE	EXISTING/PROPOSED
North Landing River Natural Area Preserve Deer Hunting Plan and Guidelines	12B: Develop and implement a deer hunting plan and guidelines.	proposed
Model Land Use Plan for Lands within the North Landing River Watershed	13A: Develop a model land use plan for priority upland tracts.	proposed
Agricultural BMP Plan for a Demonstration Farm in the North Landing River Watershed	13B: Design and implement a demonstration water quality conservation plan.	proposed
Comprehensive Access and Recreation Plan for the North Landing River Natural Area Preserve and Vicinity	14B: Develop and implement public access and recreation strategies.	proposed
Regional Scenic Resources Preservation Plan for the North Landing River Watershed	15B: Encourage a regional approach to scenic resources management.	proposed

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APPENDIX 1

**NORTH LANDING RIVER NATURAL AREA PRESERVE
MANAGEMENT PLANNING ADVISORY TEAM**

APPENDIX 1

**NORTH LANDING RIVER NATURAL AREA PRESERVE
MANAGEMENT PLANNING ADVISORY TEAM**

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APPENDIX 2

DEFINITIONS OF RARITY RANKS AND LEGAL STATUS ABBREVIATIONS

Definition of Abbreviations Used on Natural Heritage Resource Lists
of the
Virginia Department of Conservation and Recreation

Natural Heritage Ranks

The following ranks are used by the Virginia Department of Conservation and Recreation to set protection priorities for natural heritage resources. Natural Heritage Resources, or "NHR's," are rare plant and animal species, rare and exemplary natural communities, and significant geologic features. The primary criterion for ranking NHR's is the number of populations or occurrences, i.e. the number of known distinct localities. Also of great importance is the number of individuals in existence at each locality or, if a highly mobile organism (e.g., sea turtles, many birds, and butterflies), the total number of individuals. Other considerations may include the quality of the occurrences, the number of protected occurrences, and threats. However, the emphasis remains on the number of populations or occurrences such that ranks will be an index of known biological rarity.

- S1 Extremely rare; usually 5 or fewer populations or occurrences in the state; or may be a few remaining individuals; often especially vulnerable to extirpation.
- S2 Very rare; usually between 5 and 20 populations or occurrences; or with many individuals in fewer occurrences; often susceptible to becoming extirpated.
- S3 Rare to uncommon; usually between 20 and 100 populations or occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.
- S4 Common; usually >100 populations or occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats.
- S5 Very common; demonstrably secure under present conditions.
- SA Accidental in the state.
- SB# Breeding status of an organism within the state.
- SE Exotic; not believed to be native in the state.
- SH Historically known from the state, but not verified for an extended period, usually > 15 years; this rank is used primarily when inventory has been attempted recently.
- SN# Non-breeding status within the state. Usually applied to winter resident species.
- R Reported from the state, but without persuasive documentation to either accept or reject the report.
- SU Status uncertain, often because of low search effort or cryptic nature of the element.
- SX Apparently extirpated from the state.
- SZ Long distance migrant whose occurrences during migration are too irregular, transitory and/or dispersed to be reliably identified, mapped and protected.

Global ranks are similar, but refer to a species' rarity throughout its total range. Global ranks are denoted with a "G" followed by a character. Note that GA and GN are not used and GX means apparently extinct. A "Q" in a rank indicates that a taxonomic question exists concerning that species. A "?" in a rank indicates uncertainty as to that species' rarity. Ranks for subspecies are denoted with a "T". The global and state ranks combined (e.g. G2/S1) give an instant grasp of a species' known rarity.

These ranks should not be interpreted as legal designations.

Federal Legal Status

The Division of Natural Heritage uses the standard abbreviations for Federal endangerment developed by the U.S. Fish and Wildlife Service, Division of Endangered Species and Habitat Conservation.

- | | |
|----------------------------|---|
| LE - Listed Endangered | 3A - Former candidate - presumed extinct |
| LT - Listed Threatened | 3B - Former candidate - not a valid species under current taxonomic understanding |
| PE - Proposed Endangered | 3C - Former candidate - common or well protected |
| PT - Proposed Threatened | NF - no federal legal status |
| C1 - Candidate, category 1 | |
| C2 - Candidate, category 2 | |

State Legal Status

The Division of Natural Heritage uses similar abbreviations for State endangerment.

- | | | |
|------------------------|----------------------------|----------------------|
| LE - Listed Endangered | PE - Proposed Endangered | SC - Special Concern |
| - Listed Threatened | PT - Proposed Threatened | |
| - Candidate | NS - no state legal status | |

For information on the laws pertaining to threatened or endangered species, contact:

U.S. Fish and Wildlife Service for all FEDERALLY listed species
Department of Agriculture and Consumer Services Plant Protection Bureau for STATE listed plants and insects
Department of Game and Inland Fisheries for all other STATE listed animals

APPENDIX 3
SCIENTIFIC NAMES

APPENDIX 3

SCIENTIFIC NAMES

To enhance readability, common names of species are used in the text of this document. Scientific names are given parenthetically at the first use of each common name. Below, the scientific name for each common name is listed.

American frog's-bit	<u>Limnobium spongia</u>
American holly	<u>Ilex opaca</u>
Atlantic white cedar	<u>Chamaecyparis thyoides</u>
arrow arum	<u>Peltandra virginica</u>
bald cypress	<u>Taxodium distichum</u>
bald eagle	<u>Haliaeetus leucocephalus</u>
barking treefrog	<u>Hyla gratiosa</u>
beech	<u>Fagus grandifolia</u>
big cordgrass	<u>Spartina cynosuroides</u>
black needlerush	<u>Juncus roemerianus</u>
black willow	<u>Salix nigra</u>
broad-leaved cattail	<u>Typha latifolia</u>
bulrushes	<u>Scirpus</u> spp.
bur reed	<u>Sparganium americanum</u>
camphor weed	<u>Pluchea foetida</u>
canebrake rattlesnake	<u>Crotalus horridus atricaudatus</u>
Carolina lilaeopsis	<u>Lilaeopsis attenuata</u>
cattails	<u>Typha</u> spp.
common alder	<u>Alnus serrulata</u>
common reed	<u>Phragmites australis</u>
coontail	<u>Ceratophyllum</u> spp.
corn	<u>Zea mays</u>
Dismal Swamp green stinkbug	<u>Chlorocroa dismalia</u>
Dismal Swamp southeastern shrew	<u>Sorex longirostris fisheri</u>
duck potato	<u>Sagittaria falcata</u>
eastern big-eared bat	<u>Plecotus rafinesquii</u>
elongated lobelia	<u>Lobelia elongata</u>
epiphytic sedge	<u>Carex decomposita</u>
fetterbush	<u>Lyonia lucida</u>
ferns	Pteridophyta
flowering dogwood	<u>Cornus florida</u>
great blue heron	<u>Ardea herodias</u>
green ash	<u>Fraxinus pennsylvanica</u>
harlequin darter	<u>Gonphaeschna furcillata</u>
Hessel's hairstreak	<u>Mitoura hesseli</u>
hickories	<u>Carya</u> spp.
hornwort	<u>Ceratophyllum demersum</u>
inkberry	<u>Ilex glabra</u>

SCIENTIFIC NAMES (CONTINUED)

large bog cranberry	<u>Vaccinium macrocarpon</u>
laurel-leaved greenbrier	<u>Smilax laurifolia</u>
least bittern	<u>Ixobrychus exilis</u>
loblolly pine	<u>Pinus taeda</u>
naiad	<u>Najas guadalupensis</u>
narrow-leaved cattail	<u>Typha angustifolia</u>
nutria	<u>Myocastor coypus</u>
oaks	<u>Quercus</u> spp.
Olney's three-square	<u>Scirpus americanus</u>
opossum	<u>Didelphis virginiana</u>
pawpaw	<u>Asimina triloba</u>
peat mosses	<u>Sphagnum</u> spp.
pickerelweed	<u>Pontederia cordata</u>
poison ivy	<u>Toxicodendron radicans</u>
pond pine	<u>Pinus serotina</u>
raccoon	<u>Procyon lotor</u>
red bay	<u>Persea borbonia</u>
red maple	<u>Acer rubrum</u>
rushes	<u>Juncus</u> spp.
saltmeadow hay	<u>Spartina patens</u>
sawgrass	<u>Cladium mariscus</u> var. <u>jamaicense</u>
scarce swamp skipper	<u>Euphyes dukesi</u>
seaside mallow	<u>Kosteletzkya virginica</u>
sedges	<u>Carex</u> spp.
sheep laurel	<u>Kalmia angustifolia</u>
smartweeds	<u>Polygonum</u> spp.
southern bog lemming	<u>Synaptomys cooperi</u> <u>helaletus</u>
southern cattail	<u>Typha domingensis</u>
southern twayblade	<u>Listera australis</u>
soybean	<u>Glycine max</u>
spicebush	<u>Lindera benzoin</u>
spikerushes	<u>Eleocharis</u> spp.
spreading pogonia	<u>Cleistes divaricata</u>
striped skunk	<u>Mephitis mephitis</u>
swamp rose	<u>Rosa palustris</u>
swamp rose mallow	<u>Hibiscus moscheutos</u>
swamp tupelo	<u>Nyssa biflora</u>
sweet bay	<u>Magnolia virginiana</u>
sweetgum	<u>Liquidambar styraciflua</u>
switchcane	<u>Arundinaria gigantea</u>
switchgrass	<u>Panicum virgatum</u>
sycamore	<u>Platanus occidentalis</u>
tuliptree	<u>Liriodendron tulipifera</u>
twigrush	<u>Cladium mariscoides</u>
umbrella sedges	<u>Cyperus</u> spp.
Virginia chain fern	<u>Woodwardia virginica</u>

SCIENTIFIC NAMES (CONTINUED)

Virginia least trillium
Walter's sedge
water celery
water tupelo
wax myrtle
white oak
white-tailed deer

Trillium pusillum var. virginianum
Carex striata
Vallisneria americana
Nyssa aquatica
Myrica cerifera
Quercus alba
Odocoileus virginiana

APPENDIX 4

ACRONYMS

APPENDIX 4

ACRONYMS

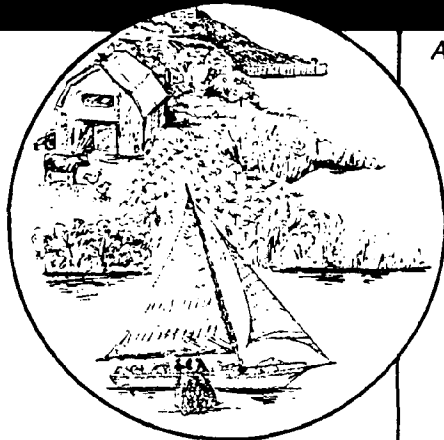
Several acronyms are used in this document. Each is defined at its first use and in the following list.

AWC	Atlantic White Cedar
BCD	Biological Conservation Datasystem
BMP	Best Management Practice
C&A	Chesapeake and Albemarle
EOR	Element Occurrence Record
DPRR	Division of Planning and Recreation Resources
DNH	Division of Natural Heritage
DSP	Division of State Parks
DSWC	Division of Soil and Water Conservation
DVCS	Division of Volunteerism and Constituent Services
GIS	Geographic Information System
ICW	Intracoastal Waterway
NAMT	Natural Area Management Team
SBR	Site Basic Record
SSS	Site Stewardship Summary
TNC	The Nature Conservancy
TBR	Tract Basic Record
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USCG	United States Coast Guard
USGS	United States Geologic Survey
VDCR	Virginia Department of Conservation and Recreation
VDoF	Virginia Department of Forestry
VDGIF	Virginia Department of Game and Inland Fisheries
VDSWCD	Virginia Dare Soil and Water Conservation District

Appendices:

D. Natural Resources Profiles

THE Chesapeake BAY



THE MANY FACES OF THE CHESAPEAKE

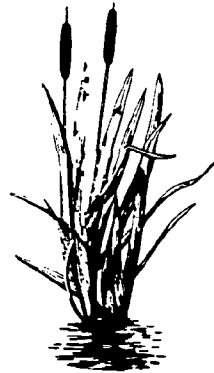
The very words, Chesapeake Bay, evoke a kaleidoscope of images, place names, and folklore. It is the nation's largest estuary, a place where salt water from the ocean meets fresh water from rivers, and its impressive stature is reflected in the early names that paid the Bay tribute: "Great Waters," "Mother of Waters" and "Great Shellfish Bay." Throughout history, the Chesapeake has played an integral role in the lives of its people. If you were a Susquehannock Indian living in the early 1600s, the Bay was a mystery—both a source of edible delights and a pathway for your adversary, the Piscataways. If you were a soldier in the War of 1812, you might have fought some bloody battles on its waters. And if you were a coffee merchant in Baltimore in the early 1900s, you very likely depended on the arrival of "The Josephine" for your livelihood.

Indeed, the Chesapeake Bay and its complex ecosystem defy easy description and understanding. From its origins at Cooperstown, New York to its mouth in southern Virginia, one can witness geographical and biological diversity to match the wide spectrum of cultures that exist here: Amish farmers, government workers in the Nation's Capitol, sailors on a weekend excursion in Norfolk, sixth-generation watermen whose trace of Elizabethan accent confirms their Cornish heritage. This fact sheet can only give you a taste of the Bay's history, ecology and challenges. Consider it an invitation to learn more and as you learn, to take an active role in Bay restoration.

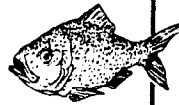
CHESAPEAKE PAST: A Bit of History

In our concern over today's pollution headlines and our apprehension for the Bay's future, we sometimes forget the hundreds of years of human events that combined to set the stage for the Chesapeake's current dilemma. Where did it all begin? Historians disagree on who was the first European to travel

ALLIANCE FOR THE CHESAPEAKE BAY



Baltimore



SUSQUEHANNA

Washington



CHOPTANK

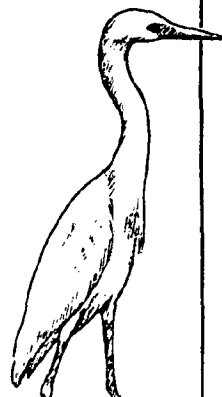
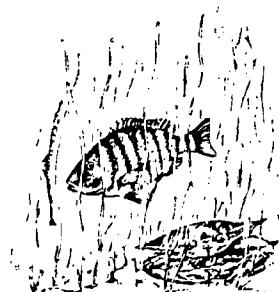
PATUXENT

POTOMAC

RAPPAHANNOCK

YORK

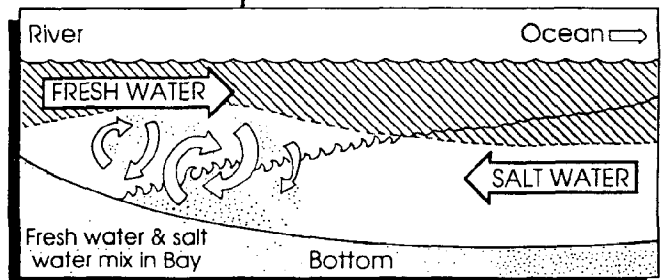
JAMES



into the Bay's mouth. Some accounts credit the Viking explorer, Thorfinn Karlsfenni as early as the 11th Century. Others claim that the Italian, Giovanni da Verrazano, set foot on its shores when he sailed along the coast from the Carolinas to Maine in 1524. And yet a third group credits Pedro Menendez de Aviles, the Spaniard who founded St. Augustine in 1566. Regardless of who was first, it was the start of big changes for the Bay as Europeans came in search of treasure, conquest and resources to fuel expanding commercial ventures and burgeoning colonial empires.

Of course, the Europeans did not find the Bay region uninhabited—Native Americans had been in residence since 8000 B.C. The Native Americans had already cleared fields, established large towns, and were managing woodlands for hunting. Archaeology provides evidence of the extent of the Indians' use of Bay resources. Every year, empty oyster shells were stacked on top of the past year's discarded shells to form piles known as "midden heaps." The largest recorded midden heap was between 18 and 20 feet deep and covered 30 acres near Popes Creek on the Potomac River.

Still, the Bay the Europeans found was so rich and productive it seemed boundless and inexhaustible. The early colonists adopted some Native American ways, (like eating oysters and smoking tobacco) and from the Indian word "Tschiswapeki" derived the name "Chesapeake." They took over the ready-made fields, and established their own towns on the old



Indian sites. The town of Crisfield, Maryland, for example, was built atop old oyster shells in 1663.

As the European settlements grew, more and more land was cleared in the effort to "tame the wilderness." By 1675, all of Virginia's Eastern Shore had been parceled out. Over time, new technologies like the gun and the moldboard plow began to reshape the Bay system in ways we are only now beginning to comprehend. And from the earliest days of colonial history to modern times runs

a constant thread—conflict over ownership of the Chesapeake's riches. Warfare, piracy, forced labor, and bloody disputes over boundaries and oyster bars have all left their marks. Many of today's policy debates are rooted in such past conflicts.

CHESAPEAKE PRESENT: A Complex and Fragile System

Geologically speaking, Chesapeake Bay is very young. It was created by the death of the last Ice Age, some 12-18,000 years ago. As the glaciers retreated and the polar ice caps shrank, the huge volume of melting ice caused sea level to rise. The rising ocean in turn engulfed the coast and flooded the river valley of the ancient Susquehanna river, creating Chesapeake Bay. The Bay we know today is nearly 200 miles long, fed by 48 major rivers and 100 small tributaries draining a 64,000 square mile basin. Earth and water continue to compete for this territory, redrawing the shoreline as land is built up in some areas and lost beneath the waves in other places. People have also redrawn shorelines, often on a much faster scale than nature. Excessive clearing and poor land management have increased upland erosion, sending tons of sediment downstream. As a result, communities that were once important ports are now landlocked. On the other side, the construction of seawalls and breakwaters has interfered with the natural flow of sand, causing beaches to rapidly erode.

Saltwater mixes into the Bay from the Atlantic Ocean. Freshwater flows from the Bay's tributary rivers, with about 50 percent coming from the Susquehanna. Saltwater is heavier than freshwater, so it tends to "creep" up the Bay along the bottom while the freshwater flows down from the tributaries on the surface. As a result, the Chesapeake ranges from totally freshwater areas in the North and upstream in its rivers, to areas near the Bay's mouth that are about as salty as the ocean.

Thus, the Bay can support both fresh and marine life forms, plus those that can tolerate fluctuating salinity levels. The variety of conditions supports some 2,700 species. All are linked in a complex, interdependent web of producers and consumers. From the eagle's huge nest high in a wetland tree to the worms in the Bay's bottom sediments, from the micro-

scopic free-floating plants to the pine trees along the Shenandoah, all have a part in maintaining this system's balance.

The Bay's physical nature as an estuary is both the source of its richness and the source of its vulnerability. The overall proportion of fresh and salt water in the Bay depends largely on the amount of rainfall that is carried to the Bay from the Chesapeake's major rivers. During a wet year, the entire Bay will be somewhat fresher than normal, and conversely a dry year will result in higher-than-average salinities. The Bay is also dependent on the quality of freshwater flowing from the tributaries. Pollution flowing to the Chesapeake tends to stay there—either in the water column, the bottom sediments or the Bay's living resources.

CHESAPEAKE AT RISK: A Diversity of Problems

What ails the Chesapeake? For people working to restore the Bay, this is a commonly heard question and one that defies simple explanation. Depending on where you are in the Chesapeake, the problem is different. Highly industrialized areas such as the ports of Baltimore and Hampton Roads have suffered from years of toxic heavy metals and dangerous chemical compounds dumped by neighboring industries. In other urban areas, such as the Anacostia and Potomac rivers, runoff from the land, huge flows of treated wastewater, and contaminated sediments are to blame. In the northern and inland reaches of the watershed, runoff from agricultural lands bringing sediments, nutrients and pesticides is the culprit. In short, the answer to "What ails the Bay?" is "you and me." Each one of us contributes to the Bay's woes by the activities that we undertake each day. From driving our cars, to flushing our toilets, to using toxic chemicals, we represent the source of the Bay's problems.

A particularly difficult pollution problem in the Bay and its rivers is excess nutrients—nitrogen and phosphorus. Nutrients wash off the land in sediments and fertilizers, and enter the Bay from sewage treatment plants. In overabundance, they set off a chain reaction, causing phytoplankton to grow explosively or "bloom", then die and sink to the bottom. Bacteria begin to decompose the dead algae and in the process use up

much or all of the water's dissolved oxygen. Such areas of low or no dissolved oxygen cannot support other Bay creatures.

Population growth and its effect on the Bay is the most complex and politically sensitive issue facing Bay managers today. A study released in January, 1989 by the 2020 panel—a commission appointed by the Bay state governors—predicts another 2.6 million residents (20 percent increase) in the watershed by the year 2020. A population increase of this magnitude translates into extensive changes in current land use patterns to more developed land. If this growth is not rationally planned, the report warns we will all pay the costs in the form of more pollution, inadequate infrastructure, and more expensive transportation. Many fear that sprawling or scattered development will undermine the progress made by Bay restoration efforts thus far.

BAY RESTORATION: Identifying the Problem

Efforts to halt the degradation occurring in Chesapeake Bay started as early as 1973, when then-Senator Charles Mathias conducted a tour of water quality problems in the estuary. The trip resulted in a conversation with the administrator of EPA and eventually led to a five-year, \$25 million EPA study. Out of ten candidate issues, three were chosen as targets for the study: nutrient enrichment, toxics, and the disappearance of underwater grasses (called submerged aquatic vegetation or SAV by scientists).

The report, presented to Congress in 1983, concluded that nutrient enrichment was the chief factor in the decline of SAV beds. Responding to the serious implications of the study's findings and underscoring their commitment to the Chesapeake, the Bay states and EPA signed the first Chesapeake Bay Agreement in December, 1983. Programs were soon put in place to begin reducing the input of nutrients and Baywide coordinated monitoring and modeling began.

A second Bay Agreement, signed in 1987 by the governors of Pennsylvania, Maryland and Virginia, the Mayor of the District of Columbia, the Chesapeake Bay Commission and the EPA, expands upon the first agreement and delineates state and federal participation through a defined set of complementary goals and objectives.

Specific commitments are outlined in such areas as water quality, public education, living resources, and population growth and development. A direct outgrowth of the Agreement is a concerted, cooperative campaign taking place in the Bay community to meet these commitments and manage the Bay's resources wisely. For the past two and a half years, such efforts have included the concerns and advice of citizens, scientists and local government officials. Proposed policies have been circulated and open to public scrutiny, inviting all of us who use the Bay to have a voice in governing it.

While the monitoring and modeling programs put into place have resulted in an extensive body of information that helps direct public policy, we are far from understanding the intricacies of so powerful a system as Chesapeake Bay. The rates and magnitude of declines in Bay resources, however, force us to set directives based upon what we do know, and to modify policies as more knowledge becomes available. In some areas of study, we are just beginning to know what questions to ask. Throughout this process, we need to keep the following points in mind:

- Each of us will affect the Bay—that fact is inescapable. However, it is up to each of us to decide whether our impact will be a positive or negative one.
- The Bay's ecosystem depends upon each of its constituent parts. We cannot sacrifice the wetlands, the tributaries, or the land, and still save the Bay.
- The Bay suffers from a variety of problems, some of which have developed over many years. We cannot expect the solutions to be quick or simple.

Chesapeake Regional
Information Service
1-800-662-CRIS

Alliance for the Chesapeake Bay
717-236-8825—Pennsylvania
301-377-6270—Maryland
804-775-0951—Virginia

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VIRGINIA POWER



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ALBEMARLE-PAMLICO PROFILES

BACK BAY

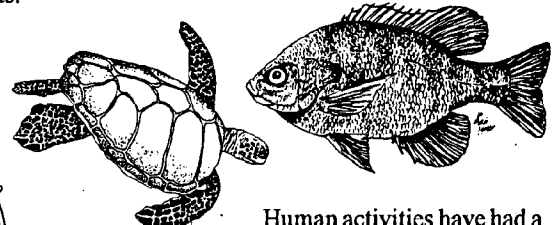
Recent concerns about water quality and fishery landings, both commercial and recreational, in the Albemarle and Pamlico Sounds resulted in a joint study by the U.S. Environmental Protection Agency and the State of North Carolina. The Albemarle-Pamlico Estuarine Study (APES) Program is an effort to identify current and potential problems in the estuary and to develop a management plan to improve and maintain the health of the estuary.

The health of Back Bay and the Currituck Sound are closely linked. Likewise, the water quality of the Currituck Sound has a great effect on the Albemarle and Pamlico Sounds. Back Bay is an expansive estuary located in the southeastern portion of the City of Virginia Beach and protected from the ocean by the False Cape barrier beach. The watershed contains 66,750 acres, including 25,100 acres of open water. An extensive network of streams and lakes drains the watershed.

The watershed is primarily undisturbed with 15,039 acres of land classified as undeveloped. An additional 9,795 acres of undeveloped land are protected in two National Wildlife Refuges, a State Park, and two state Waterfowl Management

raising, grain (field corn and winter wheat) and soybean cropping, horse breeding, and some vegetable and fruit production. Another 3,005 acres are developed for urban uses.

Back Bay has experienced only small lunar tides (maximum lunar tide range is approximately six inches) after the closing of Currituck Inlet during a storm in 1830. Since that time Back Bay has changed from a tidally influenced salt water estuary to a wind tide dominated fresh/brackish estuary. Flora and fauna within the estuary changed as well. The striped bass, shrimp, and clams that depended on salt water were replaced by largemouth bass, crappie and other fresh water inhabitants.



Human activities have had a significant influence on the Bay as well. Dune stabilization efforts along the shoreline south of Sandbridge ended periodic storm overwash. These infusions of seawater were associated with apparent increases in water clarity and submerged aquatic vegetation (SAV) growth. The flushing effect of overwash events may have been a significant factor in the hydrologic workings of the Bay.

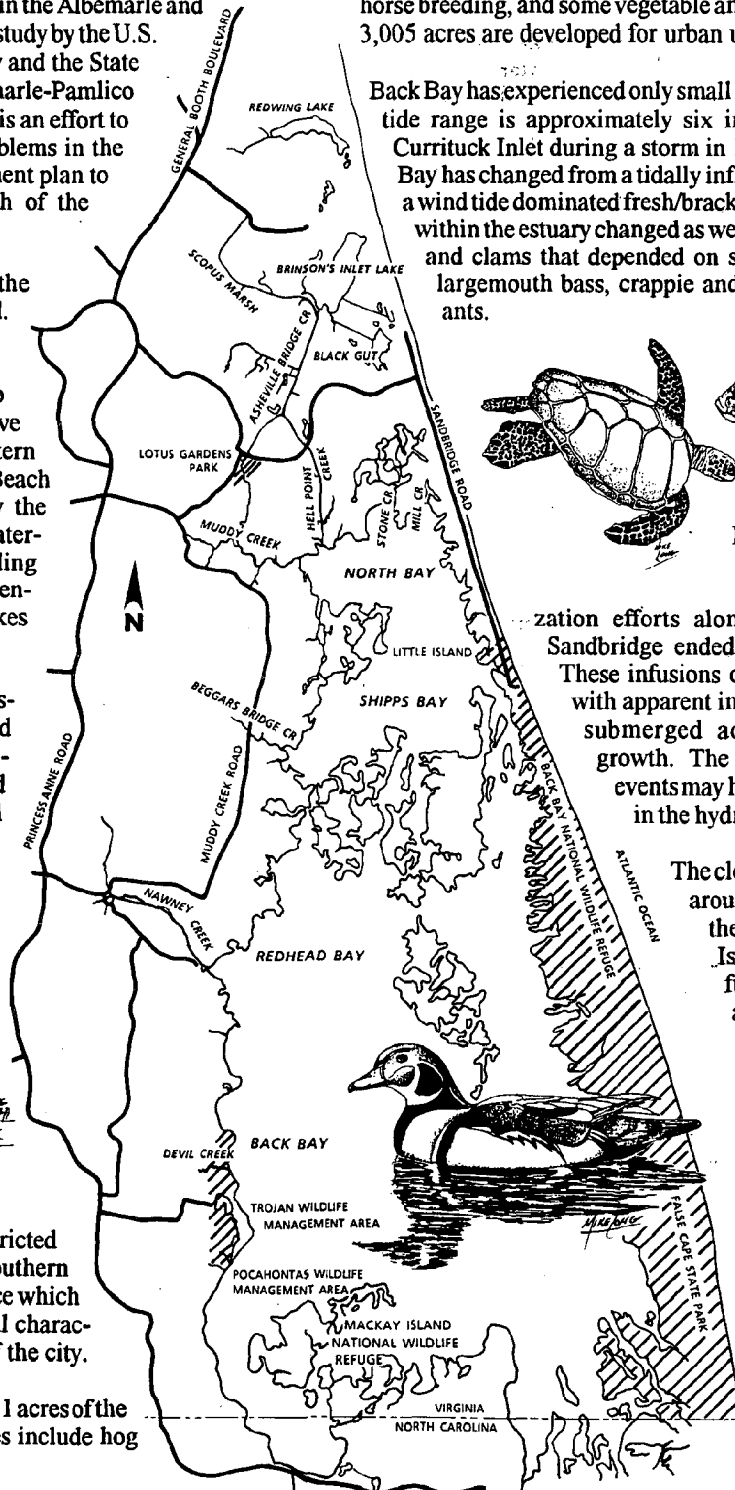
The closing of the western channel around Knott's Island, during the construction of the Knott's Island Causeway in the 1890s, further diminished lunar tides and reduced water exchange between Back Bay and the Currituck Sound. In 1920, Carrey's Ditch was dug through this area in an effort to increase flushing in the southwestern portions of the Bay.

In hopes of reversing water quality declines, the City of Virginia Beach operated a salt water pumping facility at Little Island Coast Guard



Areas. Development is further restricted by the City of Virginia Beach's Southern Watershed Management Ordinance which was established to protect the rural characteristics of the southern portion of the city.

Agricultural uses account for 13,811 acres of the watershed. Chief agricultural uses include hog



Station from 1964 to 1987 that discharged seawater into the Shipp's Bay subregion of Back Bay. Increasing the average salinity of the Bay, from 0.7 parts per thousand (ppt) (Average Bay Salinity, May 27, 1965) to 3 ppt (ten percent of the strength of seawater) was expected to increase water clarity and SAV growth without significantly impacting the fresh water species inhabiting the Bay. However, the average baywide salinity remained well below the stated goal.

In 1983, due to few pumping interruptions and low rainfall, the average baywide salinity increased to 1.5 - 1.8 ppt. Due to the circulation patterns of the Bay, however, the average monthly salinity in North and Shipp's Bays was nearly 3 ppt and a daily high of 6.42 ppt was recorded in North Bay. This may seem high, but average salinity after a storm overwash event often reached 22.5 ppt. Due to a lack of demonstrated positive effects on the Bay's resources, the pumping of saltwater into the Bay ceased in August, 1987.

Growth patterns of SAV in Back Bay have followed a pattern of introduction, colonization, stabilization, depletion, and decline. This cycle has been observed over the last century for several different species of SAV. In the history of the Bay no species has ever substantially repopulated after its initial decline.

The most recent SAV species to populate the Bay was Eurasian milfoil. First reported in the late sixties, the new grass had spread across the entire Bay in less than a decade. It flourished in areas not thought able to support plant life and grew so dense that it had to be cut back in areas of regular boat traffic. By the mid-eighties, only scattered stands and colonies in the eastern expanses of the Bay remained. This paralleled the experience of Eurasian milfoil in the Chesapeake Bay only a few years prior.

The decline in Eurasian milfoil in the Chesapeake Bay was attributed to the effects of two diseases, Northeast Disease and Lake Venice Disease. Northeast Disease was believed to be produced by a virus, a virus-like particle, or a toxin produced within and released by an infected plant. Lake Venice Disease modified the cellular structure of the leaf surface, allowing extensive algal buildup on the leaf surface. This buildup reduced the ability of the plant to photosynthesize, eventually stopping transpiration and smothering the plant. Both diseases have been identified in Back Bay.

Current research has proposed another hypothesis to explain the decline of SAV. In response to elevated nutrient levels, particularly nitrogen, SAV tends to grow so fast that its stems become fragile and crumble readily under physical stress, causing the plants to break off near the roots and die. These "corpses" can be seen commonly in both Back Bay and the North Carolina Sounds.

"The diversity and abundance of wildlife resources in the Back Bay watershed are directly related to the distribution and variety of vegetation in the area." (Mann & Associates, 1984) Back Bay is an important breeding ground, living quarters, hunting ground, rest stop, and nursery to a wide variety of terrestrial and marine life. It is particularly important as a wintering ground for mallards, black ducks, pintails, Canada geese and snow geese. For species migrating further, it acts as an important rest stop on the Atlantic Flyway. Loggerhead turtles come ashore at False Cape to lay their eggs. White tailed deer, red fox, opossum, raccoon, gray squirrel, red tailed hawk, and a host of other species make a home in the upland areas of the Back Bay watershed. The nationally threatened piping plover is thought to breed in the dunes of Back Bay National Wildlife Refuge. Other species that make their homes in the Back Bay Watershed include the bald eagle, the

American peregrine falcon, and the brown pelican.

Back Bay has a limited ability to assimilate pollutant loads. There are only two permitted point source discharges with combined flows of less than 50,000 gallons per day of secondary treated domestic wastewater.

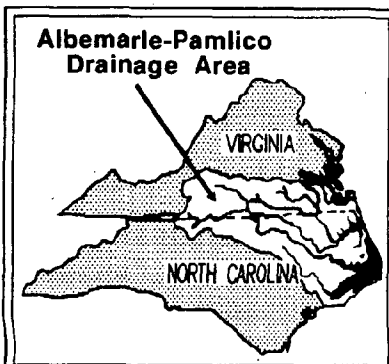
Non-point sources contribute significant pollutant loads to Back Bay. Runoff from agricultural fields and swine feed lots, and to a lesser extent from urban development, contribute pesticides, phosphorus, and nitrogen.

Within the watershed are eight swine raising operations, which use anaerobic waste lagoons to manage animal wastes. These lagoons are expected to be maintained and pumped out on a regular basis, with the waste being applied to the land. A recent evaluation of the issue concluded that on a collective basis, the equipment and the necessary access for management do exist. It was determined that water quality was not negatively impacted by the current state of hog waste management in the Southern Watersheds.

Recreational activities in the watershed include both boat and shore fishing, hunting, canoeing, wildlife observation, water skiing, biking, and camping.

The City of Virginia Beach recently completed a Southern Watershed Management Area Report, which identifies several problems in the watershed, and outlines recommended strategies and solutions for dealing with them.

The Back Bay Watershed has been designated as a component of the Back Bay Focal Area for implementation of the North American Waterfowl Management Plan. This program and other state, regional, and local efforts are expected to enhance environmental conditions in the Watershed.



This Albemarle-Pamlico Profile ...

... was produced by the Hampton Roads Planning District Commission with funding from the Albemarle-Pamlico Estuarine Study. The Albemarle-Pamlico System, second largest estuary in the nation, drains 30,000 square miles in two states. The Study is authorized by the Clean Water Act of 1987 and is funded jointly by the US EPA and the State of North Carolina. It is one of 17 national estuarine programs in the country whose purpose is to produce a management plan for maintaining the health of our estuaries. To find out more about the Study and how to get involved, call (919) 946-6481.



ALBEMARLE-PAMLICO PROFILES

NORTH LANDING RIVER

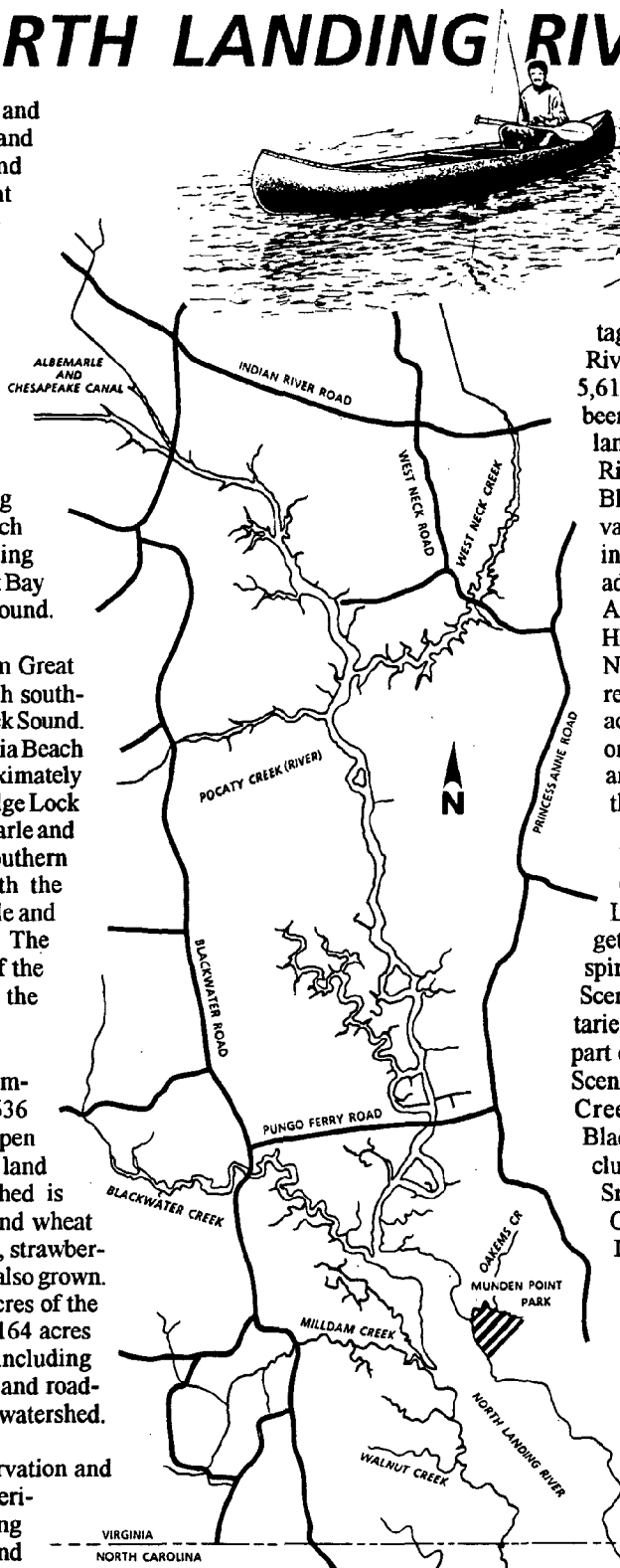
Recent concerns about water quality and fishery landings, both commercial and recreational, in the Albemarle and Pamlico Sounds resulted in a joint study by the U.S. Environmental Protection Agency and the State of North Carolina. The Albemarle-Pamlico Estuarine Study (APES) Program is an effort to identify current and potential problems in the estuary and to develop a management plan to improve and maintain the health of the estuary.

The health of both the North Landing River and the Currituck Sound, which receives water from the North Landing River, the Northwest River, and Back Bay has a direct effect on the Albemarle Sound.

The North Landing River flows from Great Bridge Locks in Chesapeake through southwestern Virginia Beach to the Currituck Sound. Its traverse of Chesapeake and Virginia Beach covers 22 miles and it drains approximately 71,794 acres of land. The Great Bridge Lock is the western terminus of the Albemarle and Chesapeake Canal which links the Southern Branch of the Elizabeth River with the North Landing River. The Albemarle and Chesapeake Canal is 8.5 miles long. The Intracoastal Waterway makes use of the North Landing as a vital part of the north-south route.

The North Landing Watershed comprises a total area of more than 74,636 acres, of which 2,841 acres are open water. Like Back Bay, the primary land use in the North Landing Watershed is agriculture. Soybeans, field corn, and wheat are the predominant crops. Potatoes, strawberries, squash, beans, and tomatoes are also grown. Agricultural activities use 32,633 acres of the available land in the basin, and 26,164 acres are undeveloped. Developed land, including residential, commercial, industrial, and roadways only cover 12,997 acres of the watershed.

The Virginia Department of Conservation and Recreation, Division of Natural Heritage, has identified the North Landing River area, as well as the Back Bay and



Northwest River areas, as one of the premiere unspoiled natural areas in the state. The North Landing area was named the top natural area in Virginia. With the help of the Nature Conservancy, the Division of Natural Heritage has established the North Landing River Natural Area Preserve. Currently, 5,612 of a proposed 10,000 acres have been acquired. The core of the protected lands extends along the North Landing River across Pungo Ferry Road east of Blackwater Road. The Nature Conservancy has acquired several more tracts in Virginia Beach and Chesapeake to add to the North Landing River Natural Area Preserve. The Division of Natural Heritage is completing fieldwork for its Natural Areas Inventory and expects to recommend acquisition of additional acreage to protect the more than 38 rare or endangered species of plants and animals that are concentrated along the river.

West Neck Creek and Virginia Beach Canal Number 2 connect the North Landing and Lynnhaven rivers. Together, these water bodies comprise the spine of the City of Virginia Beach's Scenic Waterways System. Several tributaries of the North Landing River are also part of the Virginia North Landing State Scenic River. These include West Neck Creek, Pocaty Creek/River, and Blackwater Creek. Other tributaries include Cooper's Ditch, Walnut Creek, Snake Creek, Milldam Creek, Oakem's Creek, Chelydra Stream, and Stumpy Lake.

Stumpy Lake is a reserve reservoir for the City of Norfolk's water system. Storm overflow is drained from the lake to the North Landing River. Stumpy Lake has been classified as "eutrophic" by the Virginia State Water Control Board.

The City of Virginia Beach recently completed a Southern

Watershed Management Area Report which identifies several problems in the River, as well as Back Bay's, and outlines recommended strategies and solutions for dealing with them.

Recreational activities in the watershed include both boat and shore fishing, hunting, canoeing, wildlife observation, water skiing, and power boating.

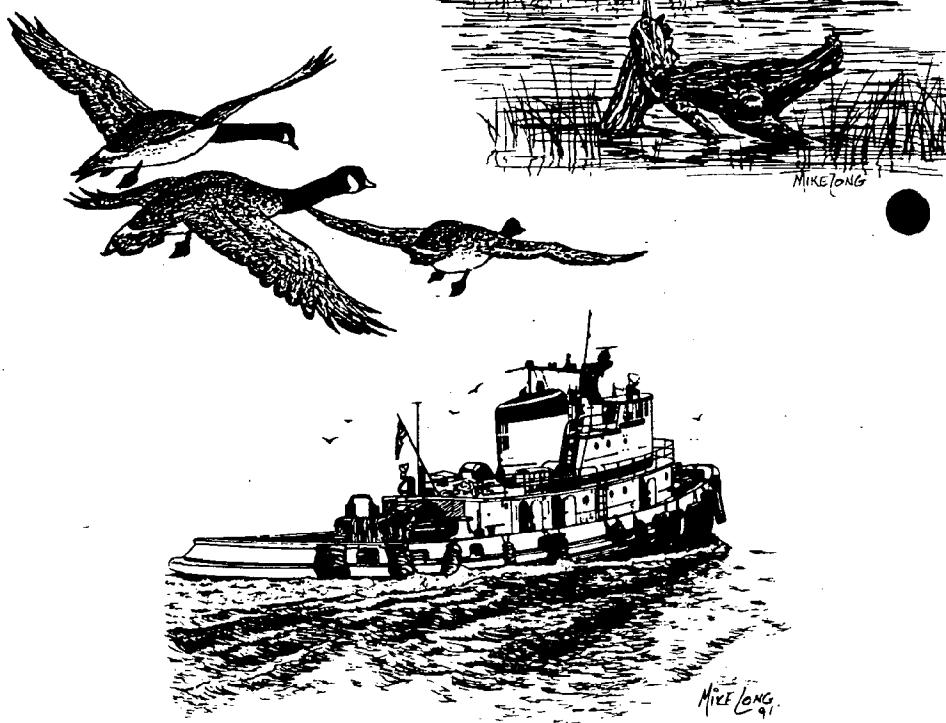
Water quality monitors have indicated the following problems in the North Landing River: low dissolved oxygen, high concentrations of fecal coliform, nutrient (phosphorous) loadings, and metals (manganese and iron). Most of these problems stem from non-point sources such as animal waste and fertilizers running off agricultural and recreational lands. Several small point sources do contribute to these problems, including the Norfolk Dredging Company, Southeastern Elementary School, Bergy's Dairy Farm, and Hope Haven - Union Mission.

The Albemarle and Chesapeake Canal once played a vital role in interstate commerce and transportation, but when water transportation was replaced by rail and highways, the canal lost much of its former importance. At one time the canal allowed both goods and tourists to flow from Norfolk to ports south. Steamboats, riverboats, and barges plied their way through the canal. In 1890, nearly 400,000 tons of freight passed through the canal's waters. Today, although still used for some commercial trips, the canal is most often used by pleasure craft making small day or week trips to the Sounds of North Carolina or those making the long voyage between northern harbors and Florida and the Caribbean.

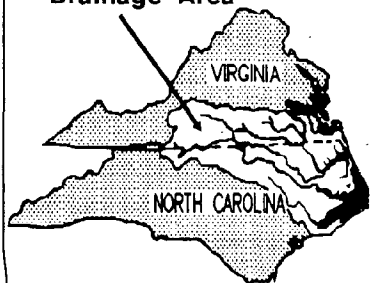
Concerns have been raised about the possible negative impacts of the Albemarle and Chesapeake Canal connecting the North Landing River and the Southern Branch of the Elizabeth River. Downstream water

quality problems are often assumed to be related to the water quality problems along the Elizabeth River. Another concern of late, however, is the link between the Lynnhaven River and the Chesapeake Bay to the North Landing River by means of West Neck Creek and Canal No. 2. Fears have been expressed about this connection, principally due to the potential for water from the Chesapeake Bay to increase salinity in the North Landing River and Currituck and Albemarle Sounds. These issues are currently being studied.

The North Landing River Watershed has been designated as a component of the Back Bay Focal Area for implementation of the North American Waterfowl Management Plan. This program and other state, regional, and local efforts are expected to enhance environmental conditions in the Watershed.



Albemarle-Pamlico Drainage Area



This Albemarle-Pamlico Profile ...

... was produced by the Hampton Roads Planning District Commission with funding from the Albemarle-Pamlico Estuarine Study. The Albemarle-Pamlico System, second largest estuary in the nation, drains 30,000 square miles in two states. The Study is authorized by the Clean Water Act of 1987 and is funded jointly by the US EPA and the State of North Carolina. It is one of 17 national estuarine programs in the country whose purpose is to produce a management plan for maintaining the health of our estuaries. To find out more about the Study and how to get involved, call (919) 946-6481.



ALBEMARLE-PAMLICO PROFILES

NORTHWEST RIVER

Recent concerns about water quality and fishery landings, both commercial and recreational, in the Albemarle and Pamlico Sounds resulted in a joint study by the U.S. Environmental Protection Agency and the State of North Carolina. The Albemarle-Pamlico Estuarine Study (APES) Program is an effort to identify current and potential problems in the estuary and to develop a management plan to improve and maintain the health of the estuary.

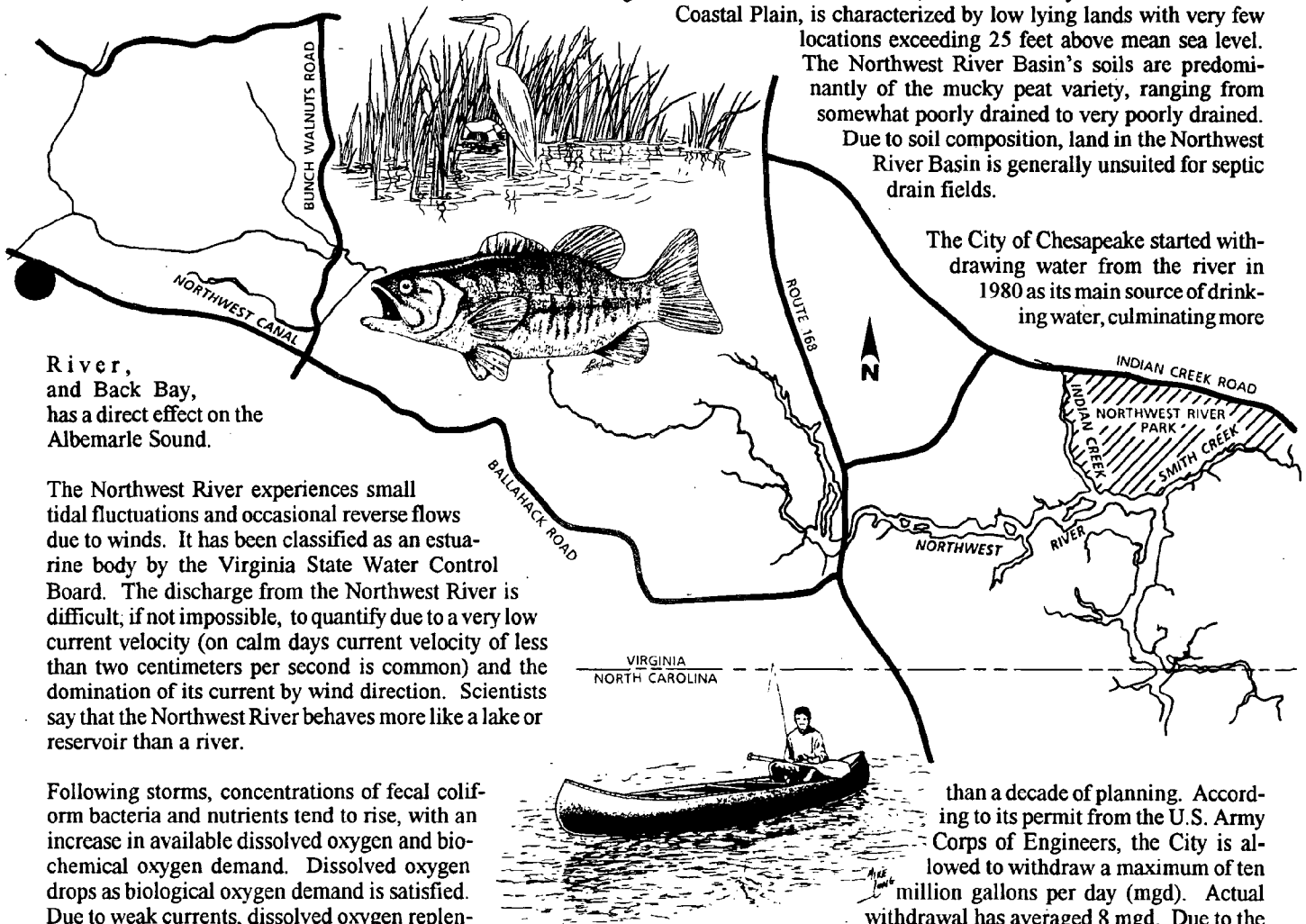
The health of both the Northwest River and the Currituck Sound, which receives water from the Northwest River, the North Landing

before entering the Currituck Sound. The drainage basin covers approximately 66,436 acres.

Land in the Northwest River Basin is primarily undeveloped, being either wetlands or unmanaged forest lands. Nearly 46,356 acres in the basin fall into this category. Agricultural lands comprise another 16,527 acres, and urban activities use only 3,554 acres of land in the basin.

The Northwest River Basin, which is entirely contained within the Coastal Plain, is characterized by low lying lands with very few locations exceeding 25 feet above mean sea level. The Northwest River Basin's soils are predominantly of the mucky peat variety, ranging from somewhat poorly drained to very poorly drained. Due to soil composition, land in the Northwest River Basin is generally unsuited for septic drain fields.

The City of Chesapeake started withdrawing water from the river in 1980 as its main source of drinking water, culminating more



River, and Back Bay, has a direct effect on the Albemarle Sound.

The Northwest River experiences small tidal fluctuations and occasional reverse flows due to winds. It has been classified as an estuarine body by the Virginia State Water Control Board. The discharge from the Northwest River is difficult, if not impossible, to quantify due to a very low current velocity (on calm days current velocity of less than two centimeters per second is common) and the domination of its current by wind direction. Scientists say that the Northwest River behaves more like a lake or reservoir than a river.

Following storms, concentrations of fecal coliform bacteria and nutrients tend to rise, with an increase in available dissolved oxygen and biochemical oxygen demand. Dissolved oxygen drops as biological oxygen demand is satisfied. Due to weak currents, dissolved oxygen replenishment is slow. Without another storm, algal blooms peak within 10 to 15 days of the previous storm.

The Northwest River flows 13 miles in a southeasterly direction across the City of Chesapeake from near the Dismal Swamp entering North Carolina at Tull's Bay. It flows another two miles

than a decade of planning. According to its permit from the U.S. Army Corps of Engineers, the City is allowed to withdraw a maximum of ten million gallons per day (mgd). Actual withdrawal has averaged 8 mgd. Due to the unusual flow patterns of the river, increased downstream salinity may result from water withdrawals from the river. This has been a major concern to the City and the regulatory agencies. In recent years, the salinity of the Northwest River has indeed increased during periods of low flow or drought. This has restricted the use of the river as a drinking water source during

these periods. In 1985 increased water withdrawals coupled with a drought and other natural occurrences combined to make water taken from the Northwest River too salty to be safely consumed by residents on salt-restricted diets. During this period, the City provided access to wells for drinking water at the municipal complex.

The Northwest River has regularly suffered dissolved oxygen depletion, high nutrient (both phosphorus and nitrogen) loadings, and pH problems. Most water quality problems are due to non-point sources and normal swamp drainage. (Swamp drainage, although a naturally occurring condition, contributes to water quality standards violations in the Northwest River.) Point source dischargers to the river include the Naval Security Group Activity - Northwest Sewage Treatment Plant, Saint Brides Correctional Center, Chesapeake Water Treatment Plant and Chesapeake WTP sludge lagoons.

According to the Virginia State Water Control Board (VSWCB) and Virginia Institute of Marine Science reports, the Northwest River, due to its estuarine type flow and swamp drainage, has a severely limited ability to assimilate pollutants. Accordingly, the VSWCB advised against siting any facilities whose activities might endanger the drinking water supply in the Northwest River Basin.

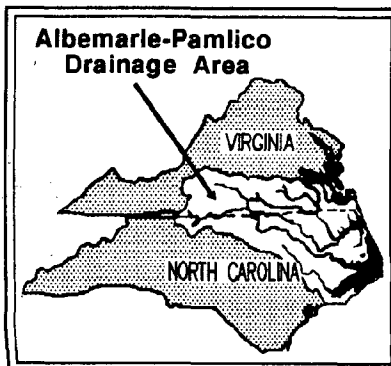
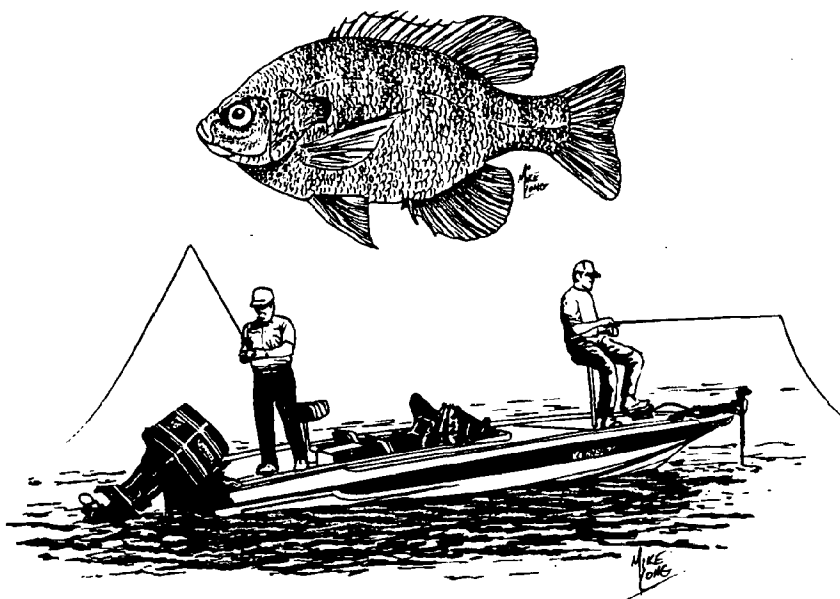
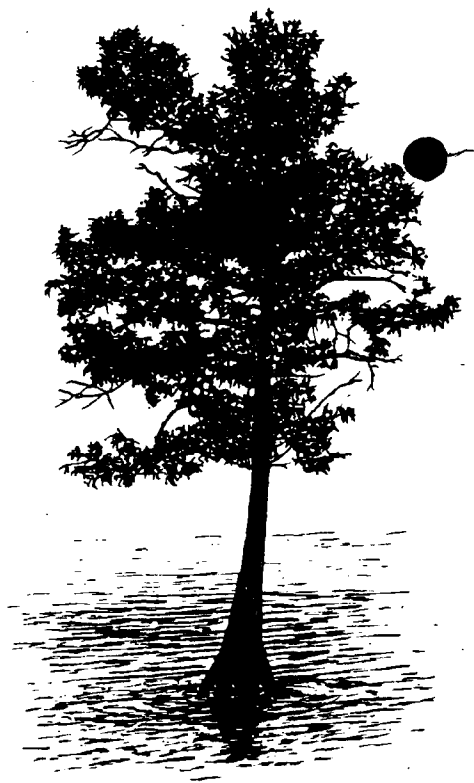
Chesapeake and state regulatory agencies classify a portion of the Northwest River as a Public Water Supply zone. This classification encompasses the area that extends five miles upstream and five miles downstream of the raw water intake point to protect the water supply. The City also restricts urban-type development within the watershed above the intake to protect the water supply.

Tributaries of the Northwest River include the Northwest Canal, Twelve Foot Ditch, Weston Ditch, Happer Ditch, Beaverdam

Ditch, Mill Stream, Indian Creek, and Smith Creek.

Recreational uses of the river include both shore and boat fishing, power boating and water skiing, wildlife observation, and canoeing. Northwest River Park, a city park, is bordered by the Northwest River along its southern border, Smith Creek and Indian Creek on its east and west borders, and Indian Creek Road on the north. This park provides easy access to the river for fishing, canoeing, row boating, and other recreational activities. The Northwest Wilderness Area in southern Chesapeake adds to natural area recreation opportunities. The Area consists of 180 acres in its natural condition and is located on the site of the Naval Security Activity, Northwest.

The Northwest River Watershed has been designated as a component of the Back Bay Focal Area for implementation of the North American Waterfowl Management Plan. This program and other state, regional, and local efforts are expected to enhance environmental conditions in the Watershed.



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